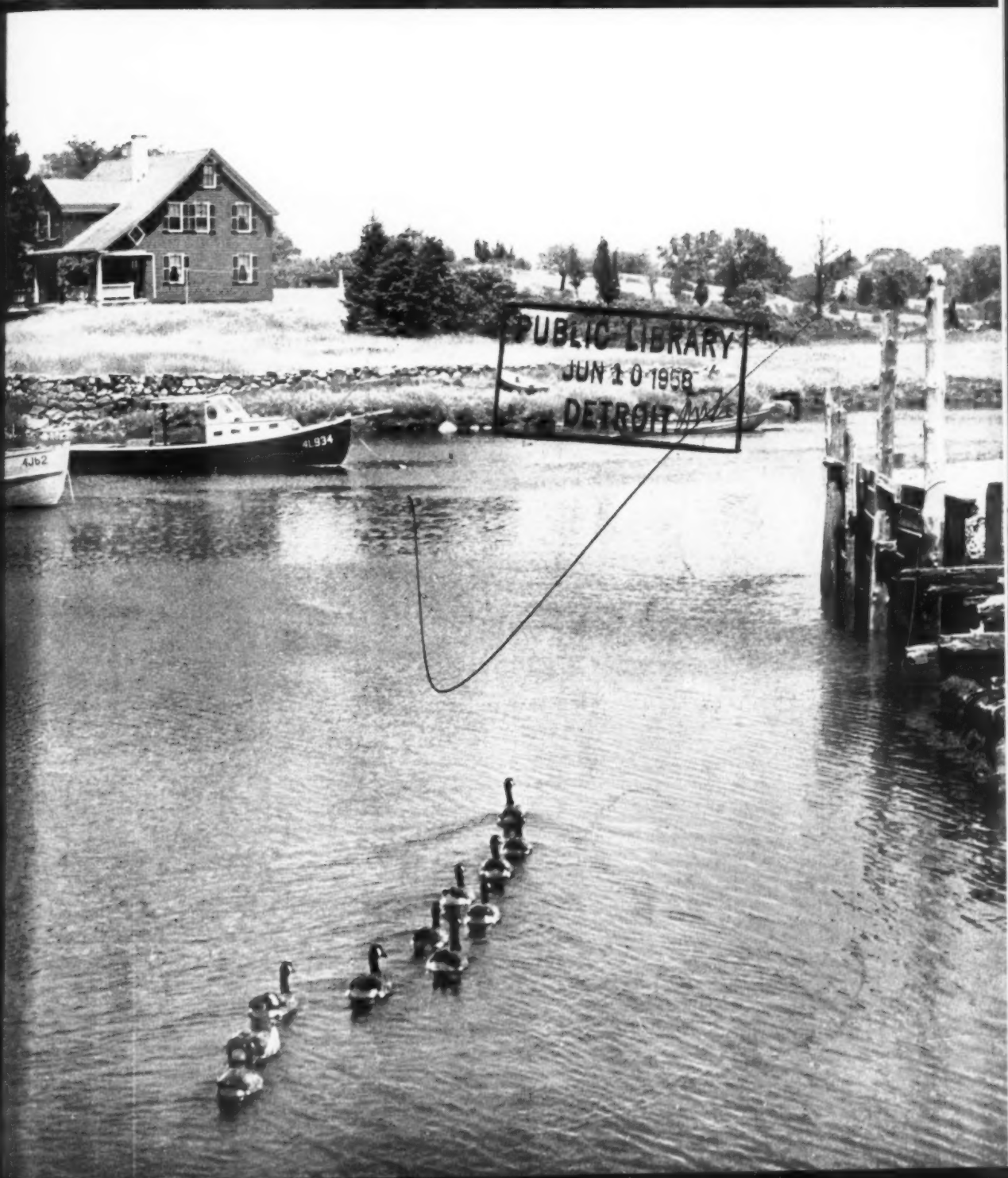
TECHNOLOGY REVIEW

June 1958

HNOLOGY DEPT.



PUBLIC LIBRARY
JUN 10 1958
DETROIT

No. 6 in a series

Right off the Wire

A computer-controller system is said to be capable of landing 120 jet planes per hour. Human control can average no better than 40 per hour.

Dockside facilities at SIMPLEX' Submarine Cable Division in Newington, N. H. are extensive enough to continuously load two of the largest submarine cable ships simultaneously.

A new plant is reported to cut the manufacturing time of industrial carbon components from eight weeks to eight minutes.

A "building block" technique, using miniature plug-in units, makes it possible to build an electronic computer small enough to go on an office desk.

An iron-aluminum alloy has been made, the behavior of which indicates that there is a relationship between rusting and magnetism.

Some fruit trees have been found to ripen earlier after long exposure to gamma radiation.

At least one of the new "exotic" rocket fuels is being made in solid form and others are expected soon.

A patent has been issued for a radioactive "go-devil" (a device for cleaning pipe lines). If it sticks in a pipe it can be located with a Geiger counter.

It is estimated that malicious damage to street lamps costs New York City a quarter of a million dollars a year. A new plexiglas globe makes this sort of vandalism almost impossible.

Instead of the usual bracing and shoring, inflatable cushions are being used to wedge freight tightly in box cars.

One of the new guided missiles is launched from an automatic base which computes the location of the attacking object, calculates its speed and the proper point for meeting it. It also loads and fires the missile automatically.

A micro-porous synthetic material holds a liquid, such as an ink or lubricant, and gives it off at a controlled rate.

Damage to small delicate parts on a conveyor can be avoided by a new belt that uses permanent magnets to hold the pieces apart.

Glass-reinforced plastics can be strengthened by the use of a special new glass containing copper oxide.

Further information on these news items and on Simplex cable is available from any Simplex office. Please be specific in your requests.

A new wool-like synthetic fiber is water-repellent, quick-drying and less expensive than other synthetics.

A device for measuring the power output of a turbine involves an inner and an outer gear in constant mesh with free space between the teeth. This space is filled with oil on which the pressure can be measured.

Simplex Wire & Cable Co. was the first to adapt interlocked armor (CONDEX) for use with underground cable in 1924.

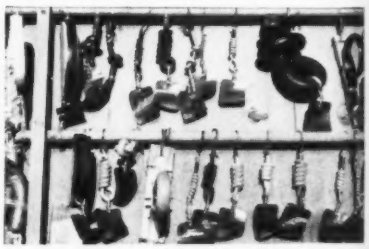
A logging company is using plastic nails to fasten logs together. They neither rust nor damage saw blades.

Paralyzed fingers can be made to move by means of tiny artificial muscles powered by a carbon dioxide cartridge.

Research conducted by two Simplex scientists in the early 1920's resulted in the first truly moisture-resistant rubber insulation. The isolation and removal of the proteins that are always present in natural rubber was the basis of the now famous ANHYDREX family of insulations.

Foamed aluminum is being made for use as a core in sandwich construction.

An electronic device checks the accuracy of aircraft guns without firing them.



Rooftop Laboratory

These cable samples, twisted and bent to exert maximum stress on insulations and jackets, are undergoing sun-crack endurance tests atop the Simplex plant at Cambridge. Many of these samples have been exposed to the elements for as long as fifteen years . . . and they haven't cracked yet. This is one example of the many punishing tests which Simplex insulating and jacketing compounds, such as Anhydrex, Thermoplex and polyethylene, are subjected to before they win final approval.

It's all part of a comprehensive system of quality control which has helped make Simplex the leader in cable research and manufacture.

SIMPLEX WIRE & CABLE CO.
Cambridge, Massachusetts and
Newington, New Hampshire

"The American manufacturers of transoceanic telephone cables"

ory

d bent
lations
n-crack
x plant
amples
nts for
d they
one ex-
g tests
cketing
hermo-
cted to

ve sys-
helped
ble re-

E CO.
nd
re

THE
Publ
Ente

Now! Constant Damping Without Warm-up

Linear Accelerometer
Type LA-500
Shown actual size.

EAR ACCELEROMETERS

r Aircraft and Missiles

DESCRIPTIVE DATA

- RANGE: Up to ±60 G full scale.
- DAMPING RATIO: 0.6 ±0.2 (from −65°F. to +175°F.).
- LINEARITY: 1% of full scale.
- PICKOFF: Can be provided with 2 potentiometer pickoffs (center taps optional).
- SIZE: 1 7/16" dia., 3 1/4" long.
- WEIGHT: 1 lb.

ONEYWELL LINEAR ACCELEROMETERS of the Type LA-500 s are true linear, non-pendulous type instruments, inherently ensitive to cross-coupling accelerations. These instruments are vailable in a variation of ranges from ±1 G to ±60 G and can be provided with two potentiometer pickoffs. Essentially constant damping is maintained automatically throughout the entire operating range of −65°F. to +175°F. No warm-up time is required.

The combination of constant damping, high performance, small size and ruggedness makes HONEYWELL LINEAR ACCELEROMETERS of the Type 500 Series ideally suited for aircraft and missile applications where the most severe environmental conditions are encountered. Write for Bulletin LA-500, Minneapolis-Honeywell, Boston Division, Dept. 1, 40 Life Street, Boston 35, Mass.

Honeywell

H HONEYWELL *Military Products Group*

THE TECHNOLOGY REVIEW, June, 1958, Vol. LX, No. 8. Published monthly from November to July inclusive at Emmett Street, Bristol, Conn., Publication date: twenty-seventh of the month preceding date of issue. Annual subscription, $4.00; Canadian and Foreign subscription, $4.50. Entered as second-class matter December 23, 1949, at the Post Office, at Bristol, Conn., under the Act of March 3, 1879.

Olivetti office machines are made and assembled in eleven factories in six countries on three continents. Founded 50 years ago, Olivetti today employs 22,000 people, makes almost every major type of office machine, has sold 3,000,000 typewriters and 700,000 calculators.

In the United States, through dealers in principal cities, Olivetti offers printing calculators, adding machines, accounting machines and typewriters that provide many time-saving features. Write Olivetti Corporation of America, 375 Park Avenue, New York 22, N. Y.

The Olivetti Divisumma 24, a high-speed single-keyboard printing calculator with automatic constant and memory, combines many individual computations into a single continuing calculation, eliminating re-entries, saving time and work.

from Tires – and Tubes – and Rubber Clothes

to Belts – and Boots – and Garden Hose

Better RUBBER Products are made with CABOT

VULCAN® and STERLING®

THE INDUSTRY'S TOP QUALITY FURNACE CARBON BLACKS

WORLD'S MOST COMPLETE VARIETY OF OIL AND GAS FURNACE CARBON BLACKS

VULCAN 9	Super-Abrasion Furnace	(SAF)
VULCAN 6	Intermediate Super-Abrasion Furnace	(ISAF)
VULCAN 3	High Abrasion Furnace	(HAF)
VULCAN XC-72 (PELLETS) (FLUFFY)	Extra-Conductive Furnace	(ECF)
VULCAN SC	Super-Conductive Furnace	(SCF)
VULCAN C	Conductive Furnace	(CF)
STERLING 99	Fine Furnace	(FF)
STERLING SO	Fast Extruding Furnace	(FEF)
STERLING V	General Purpose Furnace	(GPF)
STERLING L	High Modulus Furnace	(HMF)
STERLING LL		
STERLING S	Semi-Reinforcing Furnace	(SRF)
STERLING NS (NON-STAINING)		
STERLING R (FLUFFY)		
PELLETEX	Semi-Reinforcing Furnace	(SRF)
PELLETEX NS (NON-STAINING)		
GASTEX (FLUFFY)	Semi-Reinforcing Furnace	(SRF)

Remember too, that Cabot is the world's only manufacturer of a complete variety of ALL types of carbon black . . . channel, furnace and thermal . . . representatives in all principal cities or contact your nearest Cabot office for further details –

CABOT®

GODFREY L. CABOT, INC.

77 FRANKLIN ST., BOSTON 10, MASS.

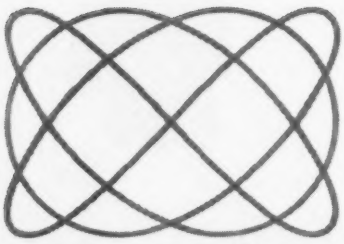
AKRON
518 Ohio Building
Akron 8, Ohio

NEW BRUNSWICK
46 Bayard Street
New Brunswick, New Jersey

CHICAGO
141 W. Jackson Boulevard
Chicago 4, Illinois

NEW YORK
60 East 42nd Street
New York 17, New York

CABOT CARBON COMPANY SALES OFFICE
1309 Main Street
Dallas, Texas



PHYSICISTS

ENGINEERS

MATHEMATICIANS

are invited to join the Lincoln Laboratory scientists and engineers whose ideas have contributed to new concepts in the field of electronic air defense.

A brochure describing the following Laboratory programs will be forwarded upon request.

HEAVY RADARS
MEMORY DEVICES
TRANSISTORIZED DIGITAL COMPUTERS
SCATTER COMMUNICATIONS
SOLID STATE
AEW (air-borne early warning)
SAGE (semi-automatic ground environment)
SYSTEMS ANALYSIS

In certain of these programs, positions of significant professional scope and responsibility are open to men and women with superior qualifications.

Research and Development

MIT

LINCOLN LABORATORY
BOX 28
LEXINGTON 73, MASSACHUSETTS

THE TABULAR VIEW

Good Policy. – A note of optimism and encouragement is struck (page 405) by WALTER G. WHITMAN, '17, who believes that persons can – and will – work for the betterment of mankind when the proper environment is created. His message is being delivered at various gatherings throughout the country; The Review's article is based on an address given before the Boston Section of the Institute of Radio Engineers last March, but adapted for the printed page by Professor Whitman, who is head of the Department of Chemical Engineering. Except for a decade when he was associated with the direction of research for the Standard Oil Company (Indiana), Professor Whitman has been a member of the M.I.T. staff since his graduation in 1917. In recent years he has had unusual opportunity to play important roles in the administration of scientific endeavors on the national and international levels. He was director of the Basic Chemicals Division of the War Production Board, 1941–1945; member of the General Advisory Committee to the Atomic Energy Commission, 1950–1956; chairman of the Research and Development Board, Department of Defense, 1951–1953; secretary-general of the United Nations International Conference on the Peaceful Uses of Atomic Energy, 1955; and president of the American Institute of Chemical Engineers, 1956.

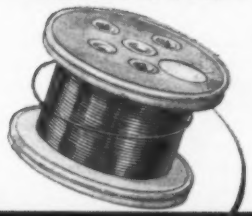
Good Potentiality. – In an examination of technology in a free society (page 408), JOHN B. RAE, Associate Professor of History at M.I.T., reminds us that if the incentive to produce is destroyed, the productive members of society are bled white to support the nonproductive ones, and economic and technological progress dies of suffocation. Professor Rae received the A.B., A.M., and Ph.D. degrees from Brown University in 1932, 1934, and 1936, respectively. He taught at Yale University, was a member of the Brookings Institution, 1936–1937, became assistant to the president of Brown University, 1937–1939, and since then has been at M.I.T. In 1956–1957 he was exchange professor of social studies at Case Institute of Technology. He is a member of the editorial board of *Business History Review* and *Explorations in Entrepreneurial History*, of the advisory board of the Lincoln Educational Foundation, and of the Executive Committee of the recently founded Society for the History of Technology.

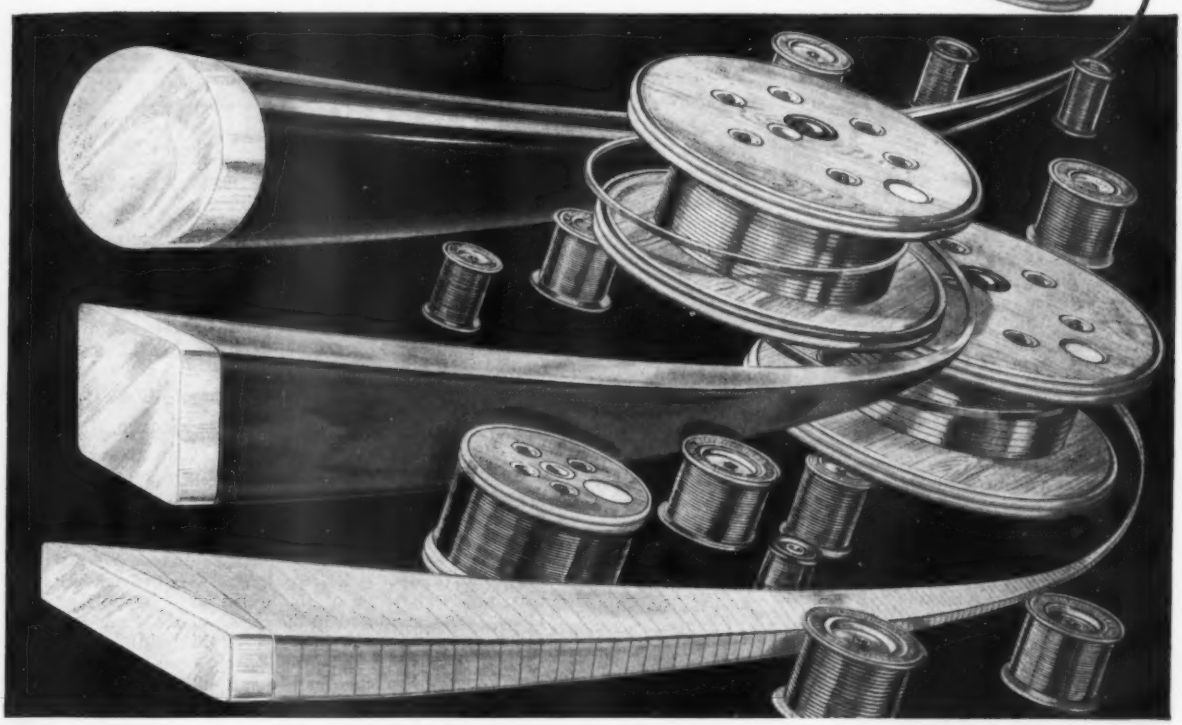
Good Resource. – With his usual ability to tackle a complex topic and reduce it to its significant elements, interestingly written, FREDERIC W. NORDSIEK, '31, outlines (page 410) man's prodigal use – and waste – of water. An editorial associate of The Review since 1941, Mr. Nordsiek needs no introduction to Review readers. For those who feel the need of additional biographical data, we refer them to the January, 1958, Review, where Mr. Nordsiek's past is exposed on page 138.

(*Concluded on page 390*)

IF MAGNET WIRE IS YOUR PROBLEM

... Phelps Dodge has the Quickest, Easiest Answer!





▶ *Most Complete and Up-to-Date Line of Magnet Wire in the Industry.*

▶ *Every Type of Insulation to Meet Design Requirements.*

Enamel • Formvar • Sodereze® • Nyleze® • Bondeze® • Thermaleze® B and F • Grip-eze®
Sylkyd • Daglas® • Daglas® Silicone • Paper • Cotton • Multiple Combinations

▶ *Available in all Sizes and Shapes—Round, Square, Rectangular . . .*

Over 400 Different Types!

First for Lasting Quality —from Mine to Market!

PHELPS DODGE COPPER PRODUCTS CORPORATION

PHELPS DODGE COPPER PRODUCTS CORPORATION

INCA MANUFACTURING DIVISION

FORT WAYNE, INDIANA

How Curtis helped a design engineer "BEAT THE HEAT"

This single universal joint in a ribbon-stripping machine was operated at a 34° angle. The joint heated up, wear was excessive. (Curtis Joints have been tested at angles up to 37°, but we do not recommend angles greater than 30°.)

Curtis engineers recommended a *double* Curtis joint, which reduced the angle to 17° per joint. Result: no overheating, improved efficiency, longer life.

You can depend on Curtis engineering in any problem of angular power transmission. And you can depend on

CURTIS UNIVERSAL JOINTS because our catalog torque and load ratings are substantiated by constant tests under production conditions.

14 SIZES ALWAYS IN STOCK
3/8" to 4" O.D.
(6" joints on special order)

Not sold through distributors. Write direct for free engineering data and price list.

TRADE MARK **CURTIS**
UNIVERSAL JOINT CO., INC.
8 Birnie Avenue, Springfield, Mass.
As near to you as your telephone

EXCLUSIVELY A MANUFACTURER OF UNIVERSAL JOINTS SINCE 1919

GEARS

Made to Your Specifications

You and we can form a team—you to draw up the specifications; we to make the gears—that will be profitable to both of us. Gears of all types, all sizes, all materials. Design-engineering service available.

Custom Gears Exclusively

DIEFENDORF GEAR CORPORATION
Syracuse 1, N. Y.

DIEFENDORF GEARS

THE TABULAR VIEW

(Concluded from page 388)

Good Riddance. — Although it once was a scourge to be greatly feared, cholera has been eliminated from the United States primarily through sanitary engineering, according to JAMES A. TOBEY, '15 (page 413). Colonel Tobey, S.B., LL.B., M.S., Dr.P.H., is a frequent contributor to The Review — as well as to other journals. He is also a well-known lecturer on public health, to which field he has devoted his entire professional career.

MAIL RETURNS

OUTER SPACE — THE NEW FRONTIER

FROM WALTER B. KIRBY, '07:

The project of the International Geophysical Year is the greatest international collaborative effort which has been attempted for peaceful purposes. Sixty-seven participating nations are engaged in this activity, and there are more than 10,000 scientists and technicians working from 2,000 major stations scattered over the entire world! For such a comprehensive endeavor to terminate in December, 1958, however great its accomplishments, would not seem to be in the best interest of the world at large.

It is conceivable that the project now in operation should be continued, and expanded to explore the intriguing prospects of outer space. Rather than one year of international cooperation, the start of a "Century of International Co-operation," in the promotion of advance space projects, might well be considered.

One of the causes of war is the expansion of overpopulated areas and the search for new frontiers. If the nations, scientists, and technicians of the world were to give as much money, time, and effort to the development of advance space problems, as they now give toward the total annihilation of the world's populace, the idea of international bickering would tend to become obsolete and unthinkable.

The attempt to explore the planets of outer space will stimulate the imagination of all peoples, and might well provide the much-needed new frontier for expansion during the next century.

Lakeville, Conn.

McKesson & Robbins, Inc.
Chapman, Evans & Delehanty Architects

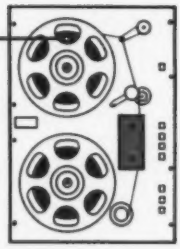
Practical Advice on Construction

Even if your construction requirements are far in the future, we suggest that you let us give you preliminary information before making any commitments.

From our data on past projects and our experience on current work, we can give you reliable information on the type of construction best suited to your needs, its cost, and time required for completion.

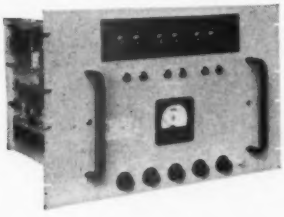
W. J. BARNEY CORPORATION
Founded 1917
INDUSTRIAL CONSTRUCTION
101 Park Avenue, New York
Alfred T. Glassett, '20, President

RAPID ACCESS



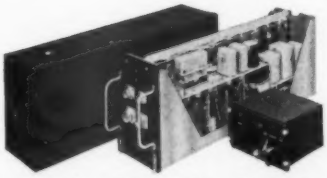
IN ANALOG DATA REDUCTION SYSTEMS

Three companion units by Hycon Eastern provide automatic indexing and high-speed access to selected data in multi-channel magnetic tape instrumentation systems.



For Tape Indexing

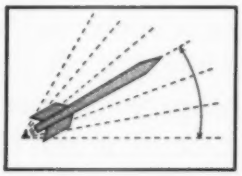
DIGITAL TIMING GENERATOR, MODEL 201, generates numerically coded timing signals which are recorded on magnetic tape throughout the data recording periods, providing a precise digital index in terms of elapsed time. The Generator also visually displays the exact time in hours, minutes and seconds as illuminated digits.



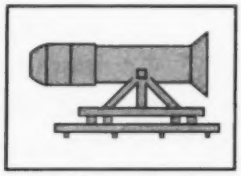
DIGITAL TIMING GENERATOR, MODEL 206A, FOR AIRBORNE APPLICATIONS is a militarized version of Model 201. A Remote Control Box contains Power off-Standby-Operate Switch, the Digital Clock Set, and the Time Display. Completely transistorized, Model 206A includes a binary coded decimal system although other timing formats are available to meet customer requirements. Weighing only 15 pounds, Model 206A is stable to 1 part in 100,000 giving an accuracy of ± 1 second in 1 day's time.

For Tape Search

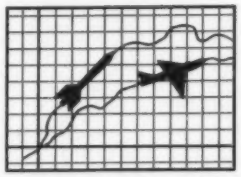
MAGNETIC TAPE SEARCH UNIT, MODEL 202, operates during data reduction periods. On the basis of time indices recorded on the tape by the Digital Timing Generator, this instrument automatically locates and selects for controlled playback the tape data included between a "sequence start time" and a "sequence end time" specified by panel dial settings. The time index is visually displayed as illuminated digits on a small separate panel which may be remotely located for convenience. Model 202 may be modified to search for timing formats other than those originated by Model 201.



WIND TUNNEL TESTING
Pressure and temperature data of missiles are referenced to angle of attack. Model 201 records on tape a digitized position signal for each new angle of attack.



JET ENGINE TESTING
Digital Timing Generator, Model 201 synchronizes all data receiving equipment. Its output can be piped to multiple test cells and control rooms simultaneously.



MISSILE AND AIRCRAFT TESTING
Model 206A generates timing signals simultaneously with other flight test data. Model 201 generates a timing code format for synchronizing ground station recordings.

Write for Technical Bulletin TSG

HYCON EASTERN, INC.

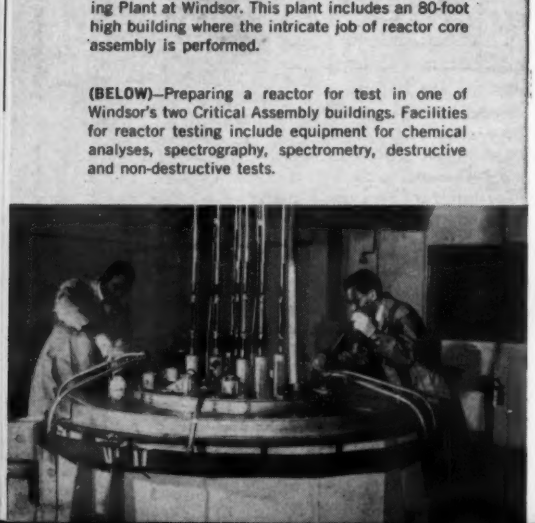
75 Cambridge Parkway Dept. H Cambridge 42, Mass.

NUCLEAR DIVISION, Windsor, Conn.

Located on a 530-acre site, this plant was completed last year. It contains facilities for all phases of reactor work except the fabrication of heavy components. Research and development facilities include Materials Development, Chemical, Metallurgical, Electronic and Mechanical Laboratories. Now under construction on the site is the country's first nuclear submarine prototype to be built at other than AEC-owned properties.

(ABOVE)—Partial view of Fuel Element Manufacturing Plant at Windsor. This plant includes an 80-foot high building where the intricate job of reactor core assembly is performed.

(BELOW)—Preparing a reactor for test in one of Windsor's two Critical Assembly buildings. Facilities for reactor testing include equipment for chemical analyses, spectrography, spectrometry, destructive and non-destructive tests.



Ready FOR T

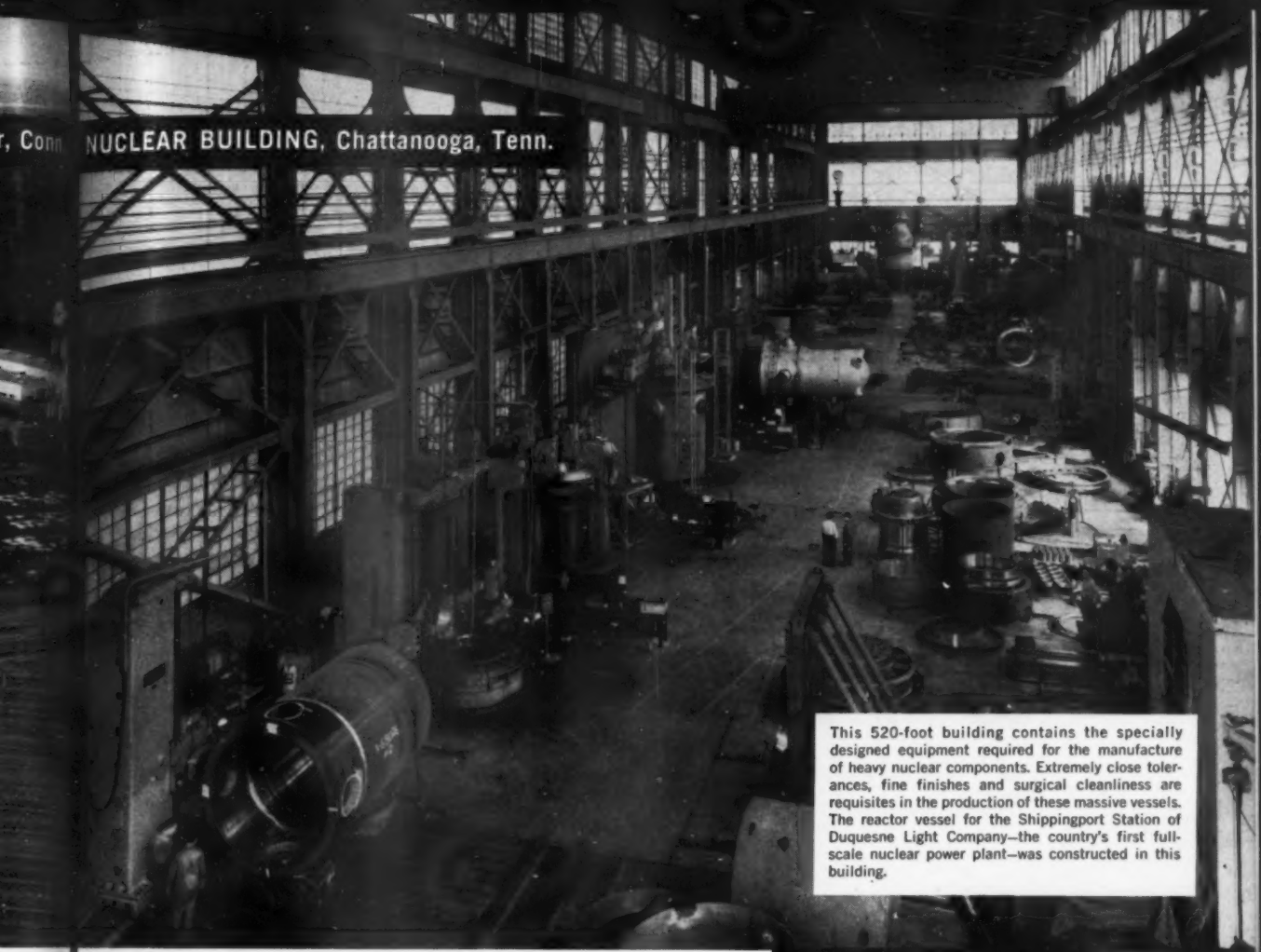
On these pages are shown Combustion's facilities for the design, development, manufacture and test of complete nuclear reactor systems including both light and heavy components. . . . These facilities, fully staffed by scientists and technicians, enable the Company to design and manufacture full-scale nuclear power installations for any requirements—civilian

or m
and
deve
Proc
as Sa
Chem
tion
will

COMBUSTION E

Combustion Engineering Buildi 00 Ma

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTOR APER MI



This 520-foot building contains the specially designed equipment required for the manufacture of heavy nuclear components. Extremely close tolerances, fine finishes and surgical cleanliness are requisites in the production of these massive vessels. The reactor vessel for the Shippingport Station of Duquesne Light Company—the country's first full-scale nuclear power plant—was constructed in this building.

OR THE ATOMIC AGE

's facil- or military. . . . Combustion is also equipped
facture and qualified to serve the nuclear field in the
ystems, development of Materials, Mechanisms and
onents. Processes, and to provide such special services
entists as Safety Consulting, Radiation Surveys, and
to de- Chemical and Biological Analyses. Informa-
power tion on these special services is available and
civilian will be sent on request.

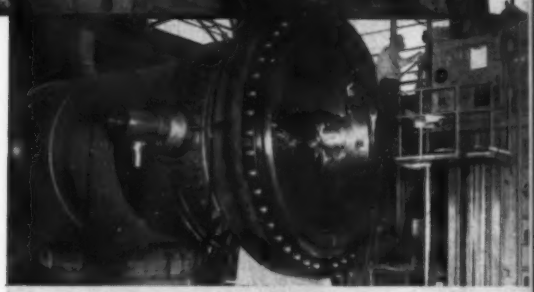
C-153

ON ENGINEERING

C-E

g Buildi 00 Madison Avenue, New York 16, N. Y.

AR REACTOR APER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE



(ABOVE)—Reactor vessel being machined on large horizontal boring mill at Chattanooga. Other specially designed equipment for heavy component fabrication includes cladders, submerged arc and pressure welders, and optical alignment devices.

(BELOW)—15-million volt Betatron X-raying reactor vessel welds. Other Chattanooga testing facilities include equipment for ultrasonic and metallographic examination.

Look for this Goodyear dealer sign for better tire values . . . better tire care ...convenient credit terms.

You get a BONUS MILE for every 4 you drive with this new 3-T Nylon Cord Tire!

3-T Nylon makes it stronger . . .

Look! 1,000 torturous runs over jagged rocks could not break Goodyear's triple-tough 3-T Nylon Cord. Reason: This nylon cord is triple-tempered under precise *tension*, at closely controlled *temperature*, for an exact period of *time*.

Result: A stronger, safer tire for more worry-free miles. See it at your nearby Goodyear dealer's.

New thicker, wider tread plus new pre-shaping process make it last 26% longer

Here is why you get bonus miles . . . Goodyear takes this new tire right from the mold and inflates it while it is still hot, which pre-shapes it, relieves undesirable tensions that rob tires of maximum miles. This precisely controlled process, plus a new huskier tread and traction design give you up to 26% longer wear . . . a bonus mile for every 4 you drive. Goodyear, Akron 16, Ohio.

NEW 3-T NYLON CUSTOM TUBELESS SUPER-CUSHION

GOODYEAR 60th

MORE PEOPLE RIDE ON GOODYEAR TIRES THAN ON ANY OTHER KIND!

Super-Cushion, T. M., The Goodyear Tire & Rubber Company, Akron, Ohio. Watch "Goodyear Theater" on TV—every other Monday, 9:30 P.M., E.D.T.

THE TECHNOLOGY REVIEW

EDITED AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

EDITOR:
B. Dudley
BUSINESS MANAGER:
R. T. Jope
CIRCULATION MANAGER:
D. P. Severance
EDITORIAL ASSOCIATES:
Paul Cohen
J. R. Killian, Jr.
F. W. Nordsiek
J. J. Rowlands
EDITORIAL STAFF:
Ruth King
BUSINESS STAFF:
Madeline R. McCormick
PUBLISHER:
H. E. Lobdell

Published monthly from November to July inclusive on the twenty-seventh of the month preceding the date of issue, at 60 cents a copy. Annual subscription, $4.00; Canadian and foreign subscription, $4.50. Published for the Alumni Association of the M.I.T.: Gilbert M. Roddy, President; H. E. Lobdell, Executive Vice-president; John J. Wilson, D. Reid Weedon, Jr., Vice-presidents; Donald P. Severance, Secretary-Treasurer. Published at Hildreth Press, Inc., Bristol, Conn. Editorial Office, Room 1-281, Massachusetts Institute of Technology, Cambridge 39, Mass. Entered as second-class mail matter at the Post Office at Bristol, Conn. Copyrighted, 1958, by the Alumni Association of the Massachusetts Institute of Technology. Three weeks must be allowed to effect change of address, for which both old and new addresses should be given.

CONTENTS for JUNE, 1958, Vol. 60, No. 8

COMMENCEMENT PROCESSION — Front Cover
Photograph by Raymond E. Hanson

CHIMNEY ROCK — Frontispiece 396
Photograph by F. S. Lincoln

OUR ATOMIC POLICY — By Walter G. Whitman 405
Scientific conferences show that persons of all nations can work together for man's welfare, and will do so if proper environment for teamwork can be created

TECHNOLOGY IN A FREE SOCIETY
By John B. Rae 408
Effort and striving, combined with adequate incentive to produce for man's welfare, are required for technology to provide greatest benefits to a free society

PRECIOUS COMMONPLACE
By Frederic W. Nordsiek 410
A natural resource, necessary to all forms of plant and animal life, and useful when in the right place at the right time in sufficient purity, is being wasted by man

AMERICA'S MANY BATTLES WITH CHOLERA
By James A. Tobey 413
Sanitary engineering has removed the scourge of cholera in the United States, but in earlier times this disease was the cause of many serious epidemics

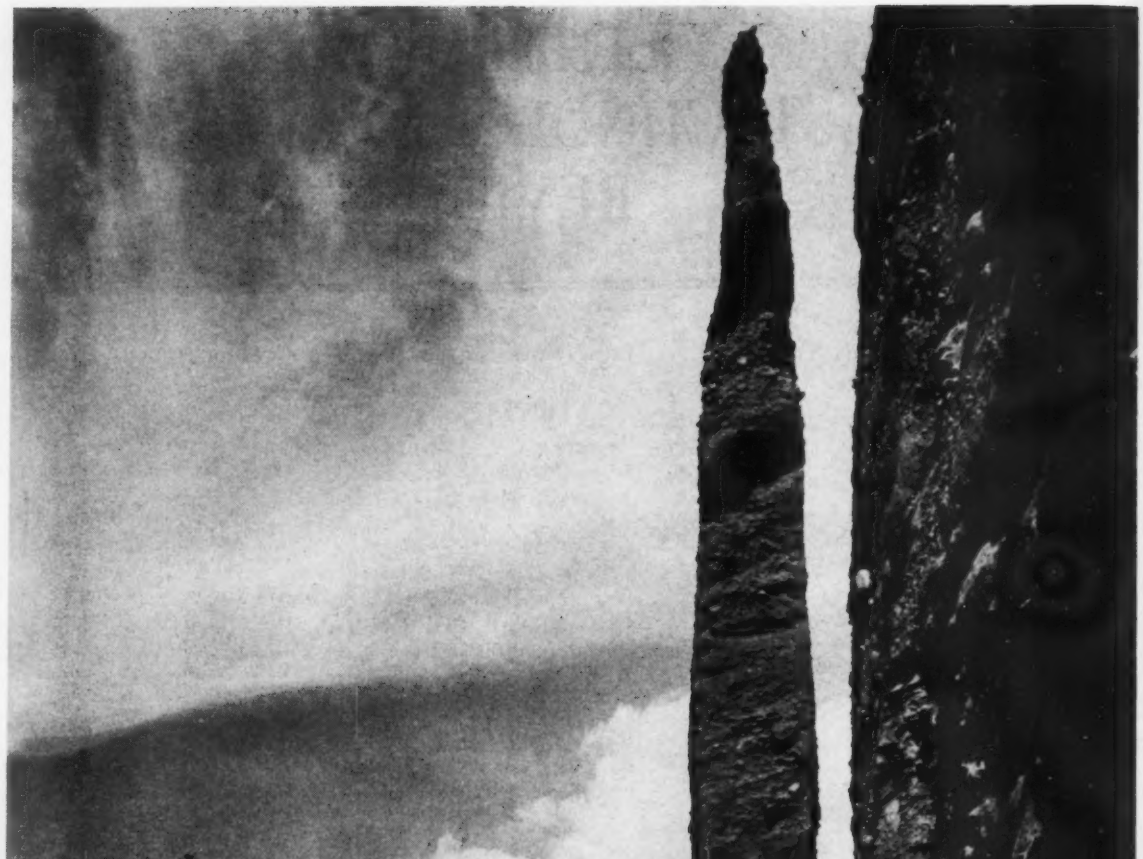
THE TABULAR VIEW — 388
Contributors and contributions to this issue

MAIL RETURNS — 390
Letter from Review Reader

THE TREND OF AFFAIRS — 397
Relating to the Massachusetts Institute of Technology

The Balclutha, *last of the full-rigged ships, as photographed at the San Francisco waterfront, where it serves as a tourist attraction.*

Photograph by Ward Allan Howe



F. S. Lincoln, '22

Chimney Rock

Vacationists, whose travels take them along routes 14 and 20 between Yellowstone Park and Cody, Wyo., will have opportunity to see this unusual display of nature, which is nearly 100 feet high.

The Technology Review

VOL. 60, NO. 8 JUNE, 1958

The Trend of Affairs

National Academy Elects Two

■ Two professors at the Institute have been elected to membership in the National Academy of Sciences, the highest honor in American science. The two elected are Thomas K. Sherwood, '24, Professor of Chemical Engineering, and Martin Deutsch, '37, Professor of Physics.

Dr. Sherwood, a resident of Concord, is widely known in educational and industrial circles as one of the country's leading chemical engineers. He has specialized in absorption and extraction, and in the mathematical applications in chemical engineering.

A native of Columbus, Ohio, Dr. Sherwood did his undergraduate work at McGill University (Montreal) and his graduate work at M.I.T., receiving the degrees of M.S. and Sc.D. in 1924 and 1929, respectively. After successive academic promotions in the Department of Chemical Engineering, he was appointed professor of chemical engineering in 1941. He served as dean of the Institute's School of Engineering from 1946 to 1952, when he was relieved of administrative duties of the Dean's Office to devote full time to teaching and research in chemical engineering. Dr. Sherwood holds the William H. Walker Award — top honor of the American Institute of Chemical Engineers — which was presented to him in 1941.

Professor Deutsch, who lives in Cambridge, is the man who first demonstrated experimentally the existence of positronium, a short-lived particle which exists for only one ten-millionth of a second. Chairman of the Directing Committee of M.I.T.'s Laboratory for Nuclear Science, he is currently pursuing a broad program of research on the radioactivity of elements and their decay products.

A native of Vienna, Dr. Deutsch received both the S.B. and Ph.D. degrees from M.I.T. in 1937 and 1946, respectively. He has been with the Department of Physics since 1939 — as instructor in 1941, assistant professor in 1945, and associate professor in 1949. He was appointed professor of physics in 1953, and that same year was the recipient of a Guggenheim fellowship. Professor Deutsch has presented numerous papers at meetings of the American Physical Society, and is the author of a chapter in Volume 1 of the *Science and Engineering of Nuclear Power.*

Beavers' Ballot

■ Indicative of the close alliance nowadays between industry and education (when each is cognizant of their dependence on one another) is the roster of important industrialists in the nation who have been elected to govern the affairs of the M.I.T. Alumni Association for the fiscal year 1958–1959, beginning on July 1, 1958.

On April 25, approximately 3,300 Alumni cast ballots to elect officers of the Association, alumni term members on the Institute's Corporation, class representatives on the Alumni Council, and members of the National Nominating Committee.

John J. Wilson, '29, Director of the Minneapolis-Honeywell Regulator Company, has been elected to serve a one-year term as president of the Alumni Association. To fill the post of vice-president for a two-year period, the ballot designated William W. Garth, Jr., '36, who is president and treasurer of Photon, Inc. He is also president, treasurer, and director of the International Photon Corporation, and Graphic Arts Research Foundation, Inc.

The two new members of the Association's Executive Committee (each elected for a two-year term) are: F. Leroy Foster, '25, Director of the M.I.T. Division of Sponsored Research; and Philip H. Peters, '37, Vice-president of the John Hancock Mutual Life Insurance Company, Boston.

Elected to serve for five years as alumni term members on the Institute's Corporation are: Donald W. Douglas, '14, Chairman of the Board and President, Douglas Aircraft Company, Inc.; Gilbert M. Roddy, '31, President and Director, Boston Manufacturers Mutual Insurance Company, and President and Director, Mutual Boiler and Machinery Insurance Company; and Robert C. Gunness, '34, Executive Vice-president, Standard Oil Company (Indiana). Mr. Roddy has been serving as president of the Association for this fiscal year which began on July 1, 1957.

New members of the National Nominating Committee (each for a term of three years) to participate in the affairs of the Alumni Association beginning on July 1, 1958, are: John A. Lunn, '17, for District 1; Jean M. Raymond, '34, for District 2; Philip L. Alger, '15, for District 4; and Hartselle D. Kinsey, '24, for District 5.

Class Reunions in 1958

Class	*Date*	*Place*	*Reunion Chairman or Class Secretary*
1893	June 16	Luncheon–M.I.T. Campus	George B. Glidden, Centre Street, R.F.D., N. Dighton
1898	June 17	Buffet Luncheon, Algonquin Club, 217 Commonwealth Avenue, Boston	Edward S. Chapin, The Eliot, 370 Commonwealth Avenue, Boston 15
1900	June 17-19	The Pines, Cotuit	Elbert G. Allen, 11 Richfield Road, W. Newton 65
1903	June 14-15	Burton House, M.I.T., Cambridge	LeRoy B. Gould, 36 Oxford Road, Newton Center 59
1908	June 13-15	*50th Reunion* Snow Inn, Harwich Port	Leslie B. Ellis, 230 Melrose Street, Melrose 76
1913	June 13-15	Oyster Harbors Club, Osterville	William R. Mattson, 28 Brookdale Road, Newtonville 60
1916	June 13-15	Chatham Bars Inn, Chatham	Harold F. Dodge, 96 Briarcliff Road, Mountain Lakes, N.J.
1918	June 13-15	The Treadway Inn, No. Falmouth	John W. Kilduff, Estes Street, Amesbury
1923	June 13-15	The Pines, Cotuit	Wentworth T. Howland, 1771 Washington Street, Auburndale 66
1928	June 13-15	Marshall House, York Harbor, Maine	Walter J. Smith, 209 Waverly Street, Arlington 74
1933	June 14-16	*25th Reunion* Baker House, M.I.T., Cambridge	Charles C. Bell, 180 Wamponoag Road, E. Greenwich, R.I.
1938	June 14-15	Chatham Bars Inn, Chatham	John R. Cook, Wendling Farm, Williamstown
1943	June 13-15	Royal Club Hotel, Megansett Beach, Falmouth	Ralph E. Leader, 123 Country Way, Needham
1948	June 13-15	Curtis Hotel, Lenox	Robert H. Bliss, 55 Arbor Street, Wenham
1953	June 14-15	Wentworth-by-the-Sea, Portsmouth, N.H.	Marion C. Manderson, 100 Martin Street, S. Acton

President of Alumni for 1958–1959

Fabian Bachrach

John J. Wilson, '29 . . .

is director of the Minneapolis-Honeywell Regulator Company. Mr. Wilson has acquired familiarity with the affairs of the Association by serving as vice-president from 1955-1957, Alumni Council member since 1950, and Class Agent since 1951.

Mr. Lunn is vice-president of Kendall Company in Boston. His Institute and Association affiliations have been numerous – as an officer of the New Haven County M.I.T. Club, a member of the Association's Executive Committee, vice-president and then president of the Alumni Association, alumni term member of the Corporation, member of the Committee on Nominations for Departmental Visiting Committees, member and chairman of the Alumni Fund Board. Mr. Raymond is president of the Raymond Manufacturing Company, Ltd. and of Raymond Engineering Products, Ltd. of Lachine, Quebec. He has been an honorary secretary since 1949; president and vice-president of the M.I.T. Club of Quebec; member of the Visiting Committee on the Department of Modern Languages.

Mr. Alger is consulting engineer with the Motor and Generator Division, General Electric Company, Schenectady. An active member of the M.I.T. Club of Schenectady, he was its secretary in 1922–1923. Mr. Kinsey is president of Union Carbide Olefins Company, division of Union Carbide Corporation, New York City. He served as vice-president of the M.I.T. Club of New York from 1952 to 1956.

The 14 classes whose numerals end in four and nine elected the following representatives to serve on the Alumni Council for a term of five years: George Owen, '94, Miles S. Sherrill, '99, Eugene H. Russell, Jr., '04, Arthur L. Shaw, '09, H. B. Richmond, '14, George W. McCreery, '19, G. Raymond Lehrer, '24, Eric A. Bianchi, '29, Henry A. Morss, Jr., '34, Frederick B. Grant, '39, Robert D. Peck, 2–44, Kenneth G. Scheid, 10–44, Archie H. Harris, 3d, '49, and Robert E. Anslow, '54.

Waldo V. Lyon: 1881-1958

■ Waldo V. Lyon, '05, distinguished teacher and researcher in the field of electrical engineering died on April 24, 1958. He was professor of electrical machinery, emeritus, at the Institute. Professor Lyon had been an active member of the M.I.T. staff for 47 years, from his graduation in 1905 until his retirement in 1952.

Professor Lyon was widely known for his studies of alternating current machinery, properties of conductors, and other electrical problems involving mathematical analysis, and was the author of such books as *Problems in Electrical Engineering, Problems in Alternating Current Machinery,* and *Applications of a Method of Symmetrical Components.* He was a fellow of the American Institute of Electrical Engineers, and had written numerous technical articles on subjects on which he was recognized as an authority.

After serving as assistant and instructor in Electrical Engineering, Professor Lyon was promoted to assistant professor in 1916, associate professor of electrical machinery in 1922, and professor of electrical machinery in 1929. He was a lecturer at the Institute from 1947 to 1952.

Individuals Noteworthy

■ Prominent in the spring news were the 27 promotions, elections, or appointments as set forth below:

Earl R. Mellen, '16, as Chairman, Daystrom-Weston Company . . . *Latimer F. Hickernell, '22,* nominated as President, American Institute of Electrical Engineers . . .

William L. Hyland, '22, Edward C. Keane, '22, and *Robert W. Moir, '26,* respectively, as President, Vice-president, and Secretary, Boston Society of Civil Engineers . . .

Paul J. Cardinal, '24, as Vice-president, National Vitamin Foundation, Inc. . . . *Boynton J. Fletcher, '24,* as Vice-president, Aluminum Company of America . . . *Julien J. Edgerly, '25,* as Vice-president, Vanguard Associates, Inc. . . .

Joseph W. Palmer, '29, as Vice-president and General Manager, Stanley Home Products, Inc. . . . *Donald B. Gilman, '32,* as President, Warren Steam Pump Company . . . *Major-General John H. Hinrichs, '32,* as Chief of Army Ordnance . . .

Richard M. Stewart, '32, as President, American Brass Company . . . *Charles B. McCoy, '32,* and *W. Allen Taft, Jr., '35,* respectively, as General Manager, Elastomer Chemicals Department, and as Director of Sales, Petroleum Chemicals Division, E. I. du Pont de Nemours and Company . . .

Richard S. Morse, '33, as chairman of the Army Scientific Advisory Panel, composed of 57 scientists, engineers, educators, and industrialists . . .

Outerbridge Horsey, '33, as Minister, United States Embassy, Tokyo . . . *H. Neal Karr, '34,* as Vice-president, the Singer Manufacturing Company . . . *Wilfred D. J. MacDonnell, '34,* as President, Great Lakes Steel Corporation . . .

Frederick A. Prahl, Jr., '36, as Vice-president for Research, Compo Shoe Machinery Corporation . . .

On the Horizon

June 16, 1958 – 24th Alumni Day, 1958, M.I.T. Campus in Cambridge. Morning Conference in Kresge Auditorium, 9:45 A.M. Luncheon in Du Pont Court, 12:00 Noon. Afternoon Program, 2:30 to 4:30 P.M. Exhibits of new facilities at M.I.T.; Social Hour on Briggs Field, 5:00 P.M.; Dinner in Rockwell Cage, 6:00 P.M.; Program in Rockwell Cage, 7:15 P.M. Boston Pops Orchestra Concert in Kresge Auditorium, 8:30 P.M.

November 8, 1958 – 13th M.I.T. Alumni Regional Conference, Albuquerque, N.M.

Joseph Morgan, '37, as Chairman, Physics Department, Texas Christian University . . . *Theodore Q. Eliot, '42,* as Head, Process Technical Service Department, Texas Butadiene and Chemical Corporation . . .

Benjamin Parran, 3d, '43, as Manager of Ordnance Sales, General Electric Company . . . *Paul F. Ely, Jr., '44,* as Manager of Market Research, Bell and Howell Company, Chicago . . . *Robert Oppenlander, Jr., '44,* as Comptroller, Delta Air Lines . . .

Louis H. Roddis, Jr., '44, as President, Pennsylvania Electric Company of Johnstown, Pa. . . . *Colonel John G. Zierdt, '47,* as Chief of Staff, Army Ordnance Missile Command . . . *William H. Shenkle, '51,* as General Manager, Instrument Division, Rockwell Manufacturing Company, Tulsa, Okla.

■ Special honors recently announced or awarded to Alumni and members of the Institute Faculty include:

To *Charles E. Smith, '00,* honorary membership, by the Connecticut Society of Civil Engineers . . . to *Marshall B. Dalton, '15,* the grade of Fellow, by the American Academy of Arts and Sciences . . . to *Edward H. Barry, '16,* the grade of Fellow, by the American Society of Mechanical Engineers . . .

To *Robert B. MacMullin, '19,* the 1958 Jacob F. Schoellkopf Medal "for his original contributions to the science of Chemical Engineering, and for his achievements at home and abroad as a consulting engineer, particularly in the field of industrial electrolytic processes," by the Western New York Section, American Chemical Society . . . to *Harold F. Smiddy, '20,* the Wallace Clark Award, by the Council for International Progress in Management . . .

To *Thomas K. Sherwood, '24, Martin Deutsch, '37,* and *Hatten S. Yoder, Jr., '48,* membership, by the National Academy of Sciences . . .

To *Saul Namyet, '40,* the Clemens Herschel Award; to *Harl P. Aldrich, Jr., '47,* the Structural Section Award; and to *Howard Simpson, '48,* the Desmond Fitz Gerald Medal; by the Boston Society of Civil Engineers . . .

To *Edward S. Carter, Jr., '51,* the first George Mead Gold Medal, and to *Harold S. Oakes, Jr., '52,* a George Mead Silver Medal, awards established by United Aircraft Corporation in memory of the late George Jackson Mead, '16 . . .

To *George H. Büchi,* Professor of Chemistry, the $1,000 Fritzsche Award, by the American Chemical Society.

Change of Status

■ Effective June 30, five members of the Faculty and a member of the Library staff will achieve emeritus status. At the same time, 14 members of the Faculty become full professors, 18 will be promoted to associate professor, and 21 will be advanced to assistant professor. Not included in this tabulation are new appointments to be announced at a later date. Except where photographs were not available when this issue went to press, portraits of those retiring are shown at the bottom of this page; portraits of those promoted to full professorship also appear on these two pages.

M.I.T. Photos

E. C. Brown **G. H. Buchi** **S. H. Crandall**

Those for whom retirement becomes effective on June 30, with title of professor emeritus, are: Leicester F. Hamilton, '14, Professor of Analytical Chemistry and Executive Officer of the Department of Chemistry; George C. Manning, '20, Professor of Naval Architecture; Avery A. Morton, '24, Professor of Organic Chemistry; Walter C. Schumb, Professor of Inorganic Chemistry; and Evers Burtner, '15, Associate Professor of Naval Architecture and Marine Engineering. Professors Burtner, Hamilton, and Schumb will become lecturers for the following school year on a part-time basis. In addition, Mrs. Margaret M. de Le Vin, senior cataloguer in the Charles Hayden Memorial Library, also retires, but will continue her present work for the coming year on a part-time basis.

Professor Hamilton has been a member of the Institute's teaching staff since 1914 and was placed in charge of undergraduate instruction in chemistry in 1935. In the spring of 1942 he was made acting head of the Department of Chemistry. He has always taken an active interest in undergraduate life at the Institute. He served as chairman of the Dormitory Board from 1925 to 1949, and played a major role in organizing the 5:15 Club for commuting students. He has been secretary of the Faculty since 1953, and for the two years preceding was assistant secretary.

Professor Manning is a graduate of the United States Naval Academy with the Class of 1914 and received the S.M. degree from M.I.T. in 1920. He was a naval officer from 1917 to 1939 and joined the M.I.T. Faculty in 1936. During the past year he has been visiting professor at the University of São Paulo, Brazil, where he has directed work in that University's ship-model towing tank. He is the author of four, and the co-author of three additional, works on naval design or related topics.

Professor Morton received the A.B. degree from Cotner College in 1913, and the Ph.D. degree from M.I.T. in 1924. He has been on the teaching staff of the Institute's Department of Chemistry since 1920, and during the past year, on leave of absence. He is author of *Laboratory Technique in Organic Chemistry* and *Chemistry of Heterocyclic Compounds*, and is well known for his work in synthetic rubber.

Professor Schumb received the A.B., A.M., and Ph.D. degrees from Harvard University in 1914, 1916, and 1918, respectively. He taught at Vassar College before joining the M.I.T. staff in 1920. From 1930-1945 he was director of the Research Laboratory in Inorganic Chemistry. Professor Schumb was one of the 12 people listed in the *Chemical Bulletin*, in 1947, as among the ablest chemists and chemical engineers in the United States.

Professor Burtner received the S.B. degree from M.I.T. in 1915 and began his lifelong association with the Institute immediately thereafter. During World War I, he worked in the Scientific Section of the Portsmouth Navy Yard which was then building submarines, and later served as port engineer and marine superintendent with John S. Emery Company. He became assistant professor in 1924, and associate professor in 1931. He is the author of a chapter on Marine Engineering in the *Handbook for Mechanical Engineers* by Marks. In 1944, Professor Burtner served on the Advisory Board of the New England Association of Naval Architects and Marine Engineers.

M.I.T. Photos

E. Burtner, '15 **L. F. Hamilton, '14** **G. C. Manning, '20** **A. A. Morton, '24** **W. C. Schumb**

M.I.T. Photos

D. Durand **F. L. Friedman, '49** **D. H. Frisch, '47** **M. J. Holley, Jr., '39** **J. W. Irvine, Jr., '39**

Mrs. de Le Vin was graduated from Simmons College in 1916 with the degree of S.B., and in 1945 received the M.A. degree from Boston University. She came to M.I.T. in 1927, when the main library of the Institute was located in the dome of Building 10. Mrs. de Le Vin was appointed as a member of the Institute's staff in 1947.

The 14 men who become full professors, beginning July 1, are: E. Cary Brown, Department of Economics and Social Science; George H. Büchi, Department of Chemistry; Stephen H. Crandall, '46, Department of Mechanical Engineering; David Durand, School of Industrial Management; Francis L. Friedman, '49, and David H. Frisch, '47, Department of Physics; Myle J. Holley, Jr., '39, Department of Civil and Sanitary Engineering; John W. Irvine, Jr., '39, Department of Chemistry; Roy Lamson (no portrait available), Department of Humanities; Ithiel deS. Pool and Robert M. Solow, Department of Economics and Social Science; C. Gardner Swain, Department of Chemistry; Theos J. Thompson, Department of Nuclear Engineering; and David C. White, Department of Electrical Engineering.

The following 18 men have been promoted to associate professor: Clyde M. Adams, Jr., '49, Department of Metallurgy; David O. Caldwell, Department of Physics; Alfred D. Chandler, Jr., Department of Humanities; Noam A. Chomsky, Department of Modern Languages; Melville Clark, Jr., Department of Nuclear Engineering; Morton Finston, '48, Department of Aeronautical Engineering; Frederick D. Greene, 2d, Department of Chemistry; Hermann A. Haus, '54, Department of Electrical Engineering; John G. King, '50, Department of Physics; William L. Letwin, School of Industrial Management; Robert W. Mann, '50, Department of Mechanical Engineering; Ross E. McKinney, '49, Department of Civil and Sanitary Engineering; Erik L. Mollo-Christensen, '48, Department of Aeronautical Engineering; Jurgen Moser, Department of Mathematics; Robert C. Reid, '54, Department of Chemical Engineering; Isadore M. Singer, Department of Mathematics; Leon Trilling, Department of Aeronautical Engineering; and John S. Waugh, Department of Chemistry.

The 20 men who become assistant professors are: Albert K. Ando, Department of Economics; John C. Chato, Department of Mechanical Engineering; Charles M. Gray, Department of Humanities; Elias P. Gyftopoulos, Department of Electrical Engineering; Imre Halasz, Department of Architecture; Lawrence C. Hoagland, '55, Department of Mechanical Engineering; Harry Hughes, Department of Geology; Ralph C. James, Department of Economics; Theodore R. Madden, '49, Department of Geology; Arthur P. Mattuck, Department of Mathematics; Charles R. Niehaus, Department of Humanities; Irwin A. Pless, Department of Physics; Herbert H. Richardson, '54, Department of Mechanical Engineering; Rolf P. Scharenberg, Department of Physics; Joseph L. Smith, Jr., Department of Mechanical Engineering; Bernard P. Spring, '51, Department of Architecture; James M. Symons, '55, Department of Civil and Sanitary Engineering; Seth P. Tillman, Department of Economics; William A. Youngblood, Department of Electrical Engineering; and Zenon S. Zannetos, '55, School of Industrial Management.

M.I.T. Photos

I. deS. Pool **R. M. Solow** **C. G. Swain** **T. J. Thompson** **D. C. White**

General view of the M.I.T. mace, which is 46 inches long, is shown at the left, with details of knop embossing shown in illustrations at right and bottom of page. Of course the beaver (top of mace) is the mascot of Technology's engineers. Seal of the Institute is on sphere at bottom. Names of M.I.T. presidents are engraved on staff between two lower octagonal knops. Alternate panels of octagonal knops are embossed with symbols representing fields of study at the Institute.

M.I.T. Photos

M.I.T. Mace

■ As recorded in the July, 1957, issue of The Review (page 515), the Institute is the proud possessor of a mace. This splendid ceremonial device, a gift from the Class of 1907, represents years of painstaking craftsmanship on the part of Leverett H. Cutten, '07. As the time nears for its use in the commencement procession, The Review is happy to show, as was not possible a year ago, some of the details of this *objet d'art*.

Originally a metal club designed to be used against warriors in armor, the medieval mace has become transformed into a more peaceful instrument. When placed on the table in front of a high-ranking officer, such as the president of a university, the mace is a symbol of authority granted that official to conduct the business of his office.

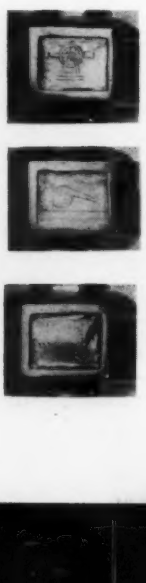
The handsome M.I.T. mace is 46 inches long with maximum diameter of about 9 inches. It is made of silver and is gold plated. The stylized eight-bladed head is crested with a beaver – the engineer of the animal world. Below the head is a spherical woven knop as decoration and three octagonal knops having embossed symbols. On the staff below the middle octagonal knop are engraved the names of the presidents of M.I.T., together with the years of their presidencies.

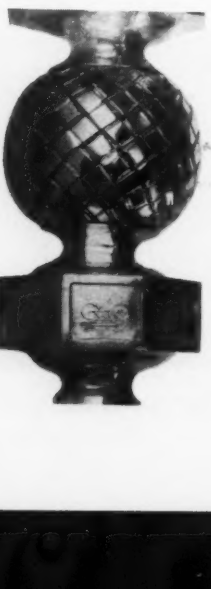
At the bottom of the mace is a sphere, or pommel, on one side of which is the Institute's seal. Separated from the seal by oak leaves, the other side shows the inscription. The oak leaves and acorn at the base of the mace are symbols of strength.

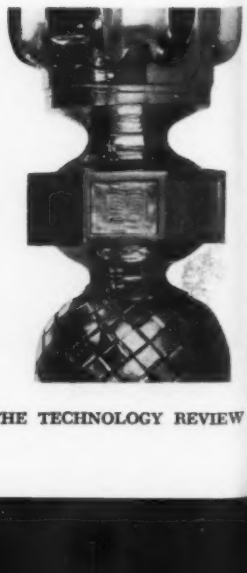
Perhaps the most interesting aspect of the M.I.T. mace is the group of symbols embossed on the knops to represent the fields of the Institute's educational endeavors. Mr. Cutten did not intend that the symbols selected should represent courses of instruction. Rather, he sought symbols expressing our technological culture and whose meanings would remain unchanged throughout the years.

Thus there are symbols for the general areas of physics (nuclear orbits and the Einstein equation), mathematics (diagram for the Pythagorean theorem), humanities (open book), biology (microscope), mechanics (enmeshed gears and turbine blades), electromagnetism (current carrying coil), chemistry (retort), civil engineering (transit), earth sciences (globe and stars), naval science (anchor), architecture (Ionic capital), and aeronautics (wing section).

The long proportions of the mace and its many curved surfaces make it difficult, if not impossible, for any photograph even to suggest the true beauty of Mr. Cutten's silversmith handicraft.







Alumni Day, 1958

■ Appropriately enough, the theme for this year's Alumni Day symposium will be "Education for a Changing World." The symposium will be held, beginning at 9:45 A.M. on Monday, June 16, in Kresge Auditorium on the M.I.T. Campus, with Association President Gilbert M. Roddy, '31, presiding. Symposium speakers will be three professors at the Institute: Morris Cohen, '33, Professor of Physical Metallurgy; Edwin R. Gilliland, '33, Professor of Chemical Engineering and chairman of the Engineering Education Committee; and Holt Ashley, '48, Associate Professor of Aeronautical Engineering.

As usual, registration for Alumni Day events will be in the new Rogers Building lobby at 77 Massachusetts Avenue, Cambridge. All who plan to attend this interesting day's events are urged to register by mail in advance.

The Alumni Day luncheon, providing opportunity to renew old acquaintance, will be held in Du Pont Court at 12:00 Noon. Addresses concerning the Institute's and the nation's scientific and educational programs will be delivered by Julius A. Stratton, '23, Acting President of M.I.T. and by James R. Killian, Jr., '26, on leave from his M.I.T. presidential post to serve as Special Assistant to President Eisenhower for Science and Technology.

At 2:30 P.M., Alumni may see the M.I.T. Nuclear Reactor; the Computation Center where the I.B.M. 704 computer will demonstrate how satellite orbits are computed; exhibits on space travel, space navigation; and laboratory equipment recently designed by the Physical Science Study Committee for high school physics courses.

A social hour on Briggs Field will precede the Alumni Day banquet which is to be held at 6:00 P.M. in Rockwell Cage. Following the highly successful practice initiated last year, the Boston Pops Orchestra, with Arthur Fiedler conducting, will conclude the day's events in Kresge Auditorium.

Twenty-five Years Ago This Month . . .

■ On June 6, 1933, at commencement exercises held at Symphony Hall to mark the graduation of the Institute's 66th class, President Karl T. Compton formally created 423 new bachelors and 146 masters of science; 22 new bachelors and 7 masters in architecture; and 10 and 17 new doctors of philosophy and science, respectively.

A. Lawrence Lowell, Life Member of the Institute Corporation and retiring President of Harvard University, delivered the commencement oration to the Class of 1933, his subject being: "The Art of Examination." He said in part:

"From teachers to committees of the United States Senate, inquisitors are apt to be unpopular with their victims. A generation ago the proceeding was often looked upon in the schools as unnecessary and objectionable. The teacher asserted that he knew how his pupils were doing, and regarded an examination as much like an indictment – a thing not to be used against good citizens – and as implying at least a suspicion of misconduct. . . .

"This is not unnatural; for examinations of that kind are given mainly for purposes of discipline – that is, to see whether the pupil has really done his work, the exact rating of individuals being of less importance. . . .

"Another object in examinations – that of measurement, rather than discipline – has lately become prominent. The increasing number of applicants for higher education, the conviction that too many college students benefit little from their instruction, a desire for a better criterion of what we are trying to do and how well we are doing it have caused a greatly increased interest in tests of ability, of attainment, and of promising qualities. . . .

"There is a third function of examinations, where the main object is neither discipline nor measurement, but education; and that aspect of the matter has not hitherto been much discussed. . . .

"Every examination, whose nature is known, set at the close of a period of study upon the subjects studied, will affect the attitude of the students toward those subjects for good or evil, becoming to that extent an integral part of the process of education; and the more it is considered by the examiners from this point of view the better its effect.

"The second way in which an examination may be a valuable part of the process of education is by requiring a systematic expression of thought. Some wise man has remarked that no one knows a subject in an intellectual way unless he can talk or write about it – that is, can express his ideas upon it. For to express oneself involves arranging one's thoughts in order, formulating, and thus clarifying them – a very different thing from answering Yes or No to a series of questions formulated by the examiner. The great art in life lies less in solving problems than in discovering the problems to be solved, and to that an examination may, in part at least, direct attention. By so doing, it can reduce the comparative weight of mere memorizing, and cause the student to make the subject his own, leading him to work it over in his mind until he can express it, not in the terms of a book or statement by a professor, but as it comes to stand in the fabric of his own thought. If he knows that at the close of his studies he will be called upon to do this, he will be inclined to prepare himself for an orderly statement of what he has learned. . . .

"Education is a vast and complex thing of which we have learned something by experience, by theory not very much; and verily the art of examination is difficult, for it aims at several distinct objects at once. These things are not to be solved by a formula, nor are any formulae either exact or essential, for there may be many roads to the same end. But one matter that has not yet received the attention it deserves, and is well worth study, is that of examinations as a vital factor in the educational process."

■ The Institute mourned the passing on June 1, 1933, of *William P. Ryan, '18,* Head of the Department of Chemical Engineering since 1929; and on June 12 of *Edward F. Miller, '86,* Head of the Department of Mechanical Engineering since 1911.

Visiting Committee Report on Metallurgy

■ A meeting of the Visiting Committee on the Department of Metallurgy* was held in the Given Room at M.I.T. on December 3, 1957. Present were: Chairman Hanley, Messrs. Given, Hollomon, LaQue, Malozemoff, Milliken, and Sawyer. C. Richard Soderberg, '20, Dean of the School of Engineering, John Chipman, Head of the Department of Metallurgy, and various Faculty members from the Department also attended the meeting.

Dr. Chipman opened the meeting by summarizing the report of last year's Visiting Committee which had stressed the need of industry for men with a broad training in the field of materials, with emphasis upon solid state technology, as well as study of metals. The Committee had recommended that the possibility of offering a degree in materials engineering be studied by the Department. It was reported that the matter was under serious consideration by the Institute and that a Committee on Materials Engineering, composed of representatives of the several engineering departments, had been appointed under the chairmanship of Professor Morris Cohen, '33.

It was the opinion of the Visiting Committee that any training in materials engineering should be concentrated in the graduate years, with the possibility of offering a new graduate degree in the field. The program should be as flexible as possible in order to draw students from many departments and to enable students to enter different fields. The Committee felt that visiting professors should be invited from industry to strengthen work in materials and that fellowships and other types of financial aid would be needed to attract graduate students into the course. The Committee pointed out that consideration of any expansion of teaching into the field of materials emphasizes the need of additional space and personnel.

Considerable time was spent discussing the research work carried on in the Department, and the methods of financing such research. It was evident that the chief problems rested in securing financing on a long-range basis, rather than on the year-to-year basis which is now common practice. In many projects, there is also a severe problem of securing expensive equipment and providing funds for maintenance. The Committee felt that the matter of overhead charges by the Institute, and the method of determining total charges for research programs, should be studied in the hope of alleviating some of the Department's financial problems in research.

It was mentioned that undergraduates, particularly below the junior year, were having difficulty in securing summer employment needed for their professional training. The Committee felt that, in all likelihood, companies would hire sophomores as well as juniors, but that it was not possible to put students on manual jobs because of union restrictions. It was suggested that the Department contact recruiting personnel to see whether companies would consider hiring more undergraduates.

It was reported to the Committee that the entire subject of undergraduate curricula was the subject of long and arduous debate and study by the Faculty at the present time.

*Members of this Committee for 1957-1958 are: Edward J. Hanley, '24, chairman, William B. Given, Jr., '08, C. Baldwin Sawyer, '17, Augustus B. Kinzel, '21, Frank R. Milliken, '34, John H. Hollomon, '40, Frank L. LaQue, and Plato Malozemoff.

Alumni Council Meeting

■ Gilbert M. Roddy, '31, President of the Association, opened the 331st meeting of the Alumni Council, held on April 28 at the M.I.T. Faculty Club, which was attended by 116 members and guests. Minutes of the meeting of March 31 were approved, and Donald G. Robbins, '07, read a resolution on the late George A. Crane, '07, which was accepted by a standing, silent vote.

As Secretary of the Association, Donald P. Severance, '38, reported that, between April 1 and April 25, nine M.I.T. clubs had been visited by 15 M.I.T. representatives. Also announced were results of the recent election, as recorded on pages 397 and 398 of this issue. Also reported were the nominations of the Executive Committee for chairmen of various important committees, to serve beginning July 1.

For the Alumni Fund Board, Avery H. Stanton, '25, reported that 11,457 Alumni had contributed $357,000 to the Alumni Fund as of April 25. This represents an increase of 6 per cent in number of contributors and a 16 per cent increase in amount, compared with figures of the corresponding date a year ago. The Alumni Council was reported as having had 100 per cent participation in the Alumni Fund.

David W. Skinner, '23, chairman of Alumni Day, 1958, reported on plans for the symposium, exhibits of new M.I.T. facilities, social affairs, and the Pops concert to be held at M.I.T. on Monday, June 16, as noted on pages 399 and 403 of this issue.

John D. Linsley, Assistant Professor of Physics described the cosmic-ray experiments to be conducted by M.I.T., beginning in June, on a 2,500-acre ranch in New Mexico. The purpose of this research is to gain greater insight into the nature of radiation received from outer space and to determine whether or not cosmic-ray showers originate in any particular portion of the sky. The experiments are intended to indicate how cosmic-ray showers originate, as well as where they originate. Nineteen stations, each with four units (a yard in diameter) will be used to catch and to count cosmic rays.

F. Leroy Foster, '25, Director of the Division of Sponsored Research, spoke on the effects of sponsored research on the university. Research work sponsored by short-term contracts places an unnecessary load on the Faculty and the Administration, and requires the university to assume undesirable risks. But such research is a very effective way of keeping Faculty members abreast of current developments, and provides an excellent opportunity for training of graduate students, and even undergraduates. In general, such research is undertaken only if M.I.T. has proper facilities, if the program contributes to its educational program, and if a Faculty member is interested in undertaking it.

(*Continued on page 420*)

Our Atomic Policy

Scientific conferences have demonstrated that men of all nations can work together for man's welfare, and will do so if proper teamwork environment is created

by WALTER G. WHITMAN

At Arden House, in the Catskills last fall, I attended a meeting on atomic energy – the 12th meeting of the American Assembly. Four former commissioners of the Atomic Energy Commission and one of its present members were present. Among the others were industrialists, engineers, scientists, lawyers, editors, economists, bankers, educators, and representatives from the labor movements, and all were leaders in their fields.

Our three days of discussion certainly did not resolve all the problems of our atomic power policy; in fact, there were some sharp disagreements on a number of issues. But on one point the agreement was unanimous – all recognized the need for the people of our country to get a clearer picture of the program and policy of the United States with respect to atomic energy. This group of leaders had found that they themselves were uninformed, or even misinformed, about many of the salient facts.

The following comments can represent only a personal interpretation, but I will try to make them reasonably unbiased. My views are not the opinions of the American Assembly, and certainly they do not represent an official policy of the Atomic Energy Commission. But I have looked at our atomic energy program from three different points of view throughout a number of years and have gained some insight from each experience.

For six years I was a member of the General Advisory Committee to the Atomic Energy Commission. For two of those years I was in the Pentagon as head of the Research and Development Board, and for another year I worked with the United Nations on the Atoms for Peace Program.

Even during World War II, careful thought was given to the use of atomic energy for production of power. In that time of crisis, however, the nation's entire effort had to be directed to winning the war, and postwar developments had to wait. Immediately after the war, some very extravagant claims were made about atomic power. It was stated, for example, that within a few years civilian nuclear power would be competitive with that derived from coal in the United States. This irresponsible and deplorable over-optimism had serious repercussions. Sober thinking soon showed the absurdity of such claims – and enthusiasm flagged.

Atomic energy for military propulsion was quite another matter. In this case, the cost per kilowatt-hour of the power produced might be entirely irrelevant to the military value of an atom-powered propulsion unit. As you know, the Navy has been notably successful in developing the atomic-powered submarine, and is now applying nuclear propulsion to surface vessels as well.

The Navy's program did not lead to economic power from the atom, and was not intended to. But, in my judgment, the Navy's application to ship propulsion has had very beneficial effects in the development of atomic power. It has made available a great deal of experience in atomic plants, it has created an industrial base for the production of power reactors, and it has resulted in the development of new materials – such as zirconium – which are especially useful for reactors.

On the other hand, the nonmilitary use of nuclear power was relatively neglected after World War II. The Atomic Energy Commission was preoccupied with weapons, particularly after the first Russian bomb was exploded. I joined the Advisory Committee in 1950, and I recall my own attitude about that time. Along with most people, I could not see why we should get excited about developing expensive atomic power when this country had adequate supplies of relatively cheap coal, oil, and gas to last for quite a period. Certainly atomic power would be useful sometime, but where was the urgency?

Our government changed its position about six years ago when it began to examine the international implications of the development of atomic power. The United States stood before the world as the leader in the development of atomic energy. The leader for what? For weapons. There was a reappraisal of the whole situation. Wasn't it most important that we should also assume leadership in the development of peaceful use of the atom? *We* might have adequate supply of fuels, but what about other countries who were not so blessed?

In December, 1953, President Eisenhower addressed the General Assembly of the United Nations in what I regard as the greatest speech by a world statesman since the war. After pointing out the utter annihilation of nuclear warfare, he called on all nations to unite in developing atomic power for the benefit of man rather than for his destruction. As you know, that inspired challenge initiated the subsequent Atoms for Peace Conference, which was held in Geneva in 1955, and the new International

Atomic Energy Agency which was established in Vienna only last fall.

Consistent with the President's policy, the Atomic Energy Commission developed a positive program on reactors involving several hundreds of millions of dollars. The purpose of the new program was to accelerate the knowledge and technology on the most promising types of reactors for power production. It was fully realized that none of these prototype reactors could produce competitive power; that first we had to build nuclear plants, gain experience in their design and construction, discover the operating difficulties, surmount them, and then build a second generation of the more promising types. By the time a third generation was built, we might have reliable and efficient atomic plants which would be competitively useful in certain areas. I shall not try to describe these plants. The point is that our present units are built to develop knowledge and experience and are not intended to feed large amounts of electricity into the country's power grid. In all these plants, the heat of fission is used to make steam; steam then goes into the power-producing turbines just as if the steam had come from a boiler fired by coal, oil, or gas.

About this time the aspect of private financing began to be emphasized in the planning. You all realize that when the federal government pays all the bills the incentives to build and to operate economically are rather marginal. Economies could be introduced if private capital were involved – if private money were at risk.

The new Atomic Energy Act of 1954 was designed to permit private investment in a field that had previously been a government monopoly. In retrospect, we can see that the framers of the 1954 Act were a bit over-optimistic in their appraisal of the economics.

The A.E.C. has issued a series of invitations to industry to present power plant projects for approval. The response to these invitations has demonstrated, with few exceptions, that the economic justification for private investment in atomic power plants does not yet exist in the United States. At the same time, however, the A.E.C. invitations have drawn many proposals from publicly financed companies who would build with government funds. This has injected domestic political issues to an alarming degree. The basic intent of the policy – to advance the development of atomic power by introducing the responsibilities which private capital might contribute – seems to have been forgotten in the heat of political battle. I regard this as a most serious deterrent to progress.

The situation in other countries is different from that in the United States, but the Geneva Conference of 1955 showed that Russia, England, and Canada were making real progress.

At first, the British built big reactors for the production of plutonium for weapons, just as we did. Later on, they built the Calder Hall type of reactor which produces plutonium while generating commercial power as well. The British are embarked on a tremendous investment for producing atomic power in the British Isles. Why are they doing it? They are quite frank in their answer. British coal is no longer adequate for their expanding power needs. They can get oil from the Mid-East, but about a year ago there was a serious crisis at Suez, and the Mid-East situation is very unsettled. The British are also buying coal from the United States. By the time that U.S. coal is delivered in England, it costs about twice what it costs here in New England. The British feel quite justified in building atomic plants which will make power at a much higher cost than would be competitive in the United States.

The situation in western Europe is very similar. There, coal is inadequate for industrial needs. Western Europe, too, must have additional power production if the people are to build up the economy to meet its planned growth. Western Europe, too, is buying United States coal at about the same price the British pay and also in scarce dollars; it also buys oil from the troubled Mid-East. Japan is in somewhat similar condition. Although an industrialized country with good water power, Japan is reaching the limit of its energy resources and needs additional fuel.

The situation in Russia is not quite so clear. Undoubtedly, much of Russia's interest in atomic power arises from its international implications, just as it does with us. But Russia does have a definite fuel shortage in western Russia which has to be met by transporting coal from Siberia, a distance of some 1,500 miles. When the cost for that rail freight is included in the cost of coal, you have rather expensive power. If we had a common yardstick, I would imagine that additional power from Siberian coal may be twice as expensive in Moscow as it is here in Boston.

I would like to summarize this part of my comments by asking a question – "Why should we be interested in atomic power?" – and answer it with three points: (1) Over the long term we will need atomic power in the United States, although there is certainly no urgency at this time; (2) Atomic power is, however, urgently needed in other countries, notably in Europe and Japan; (3) Most importantly, our world responsibilities require that the United States lead in the peaceful development of the atom. The President understands this – the citizenry must understand it if the necessary federal program is to be supported.

Viewed in this light, you can understand why I so deplore the injection of domestic politics and of the public power-private power struggle into a program where the fundamental issues are international in character.

Powerful Forces for Understanding

Let me now talk on a somewhat broader basis about a concept which, although less tangible, is being shaped, for good or ill, by our thoughts and actions every day. I have emphasized that the international aspects of the atomic-power policy are the dominant ones. This conclusion was generally accepted in the American Assembly at its meeting last fall. Yet almost everyone in that group instinctively thought of the problems and of possible solutions *only* in terms of the Cold War.

We may not see clearly any practicable alternative to the Cold War. But deep down, anyone who is

The United Nations team of scientific secretaries is shown above. Seated (left to right) *are: Michel Trocheris, France; John Gaunt, U.K.; Reinosuke Hara, Japan; Brian Urquhart, Executive Officer, United Nations; Viktor S. Vavilov, Deputy Secretary-General, U.S.S.R.; Walter G. Whitman, '17, Conference Secretary-General, Frederic de Hoffmann, U.S.; Elwyn O. Hughes, Canada; Donald J. Dewar, Canada; and Jose Leite Lopes, Brazil. Standing* (left to right) *are: Andre Finkelstein, France; Cesar A. Sastre, Argentina; Brahm Prakash, '49, India; Jakob Goedkoop, Netherlands; Ivan D. Rojanski, U.S.S.R.; Robert A. Charpie, U.S.; Nikolai A. Dobrotin, U.S.S.R.; Leonard F. Lamerton, U.K.; and Derrik J. Littler, U.K. Joining the team later (but not shown above) were: Aleksander Milojevic, Yugoslavia; Carlo Polvani, Italy; Abdus Salam, Pakistan, and Ivan Ulehla, Czechoslovakia.*

aware of the destructiveness of the present weapons, and of the ease with which they can be delivered, must know that a policy which is based entirely on the Cold War is utterly sterile; it cannot bring peace to this world. It will lead inexorably to world suicide.

In March, 1955, I was in Moscow on a mission for the United Nations. My task was to enlist the cooperation of the Russians in the forthcoming Atoms for Peace Conference. Many people, including quite a few of my friends, doubted the wisdom of trying to hold this conference. They feared that it would be another propaganda battle which would merely result in a setback to world progress. It was readily apparent that the critical problem was to dispel suspicion and distrust about the conference on the part of the Russians, as well as distrust of Russian intentions by the United States. We had somehow to establish confidence that this would be a true scientific congress in which nations would tell of their knowledge and of their plans.

It seemed to me that the most direct and constructive approach was to go to Russia and try to tell the Russians as much as possible about the plans. I began by asking the Russians whether I would be welcome in Moscow. Remember, at this time, early in 1955, the Iron Curtain was substantially impregnable. The answer from Moscow was: "Yes."

In retrospect, I regard that short visit to Moscow as most critical to the subsequent success of the conference. I could tell the Russians about the plans of the Western nations – the types of papers they intended to present, the caliber of people who were coming, and something about the exhibits which were to be set up at Geneva. Moreover, I needed Russian help in many things that had to be done, notably in the recruiting of some younger scientists to serve with me in the United Nations. The Russians were obviously startled by such frankness, but their response was quick and very gratifying. They said they would do practically everything that I asked them to do, and, furthermore, they delivered on those promises.

One minor incident on that trip was rather revealing to me; it is unimportant except that it was revealing. Remember, we knew so little about the Russians at that time, and there was quite a tendency to think that they all had horns and a tail. They took me to see a high-energy accelerator, and through the interpreter, carefully explained the accelerator to me. At this point a Russian beside me, who could speak English, leaned over confidentially and said: "You know, we are very proud of the work that Dr. Veksler is doing on this accelerator. We would so like to build a bigger accelerator, but that takes a tremendous amount of iron. Sometimes we think it would be a good idea to use some of the Iron Curtain to build a bigger accelerator." To one not prepared for this sort of a comment, my education came pretty fast.

(*Continued on page 428*)

Technology in a Free Society

The betterment of humanity comes from effort and striving. But technology provides means for creating and distributing new wealth, when proper incentives are provided to produce

by JOHN B. RAE

It is a fair guess that history will record the launching of the first space satellite as the point at which the bulk of the American people finally, belatedly, and for the most part abruptly, became aware that the advance of technology was posing urgent problems for their whole way of life, quite apart from the matter of mere physical survival. The awakening began with the atom bomb, but for some reason the explosion at Hiroshima failed to jolt us to anything like the same extent as the launching of Sputnik. Apparently this was because we could regard the bomb as "ours" and therefore as comforting evidence of our inherent superiority in technological skill and "know-how." At any rate, the fact of this new-style Great Awakening is sufficiently obvious in the contemporary American scene.

What the future historian will record about the response of the American people is another matter. We have, we may devoutly hope, recovered from the first hysterical reaction, which might well have convinced a stranger to the American scene (a visitor from outer space, for instance) that all our technological achievements, our unequaled facilities for mass production and distribution, our resources in managerial and technical skill had somehow vanished overnight, and that our entire educational system had suddenly become worthless. A deflating of complacency and a healthy soul-searching is a very profitable experience. If, however, we give way to our doubts and fears, if we lack faith in our own ideals and institutions, then we will assuredly blunder into the very evils we want to avoid.

Raymond E. Hanson, '03

Nothing in history suggests that a healthy society can exist if people are conditioned to take it for granted that government will settle all their problems for them.

The magnitude of the problem is indisputable. Technology has put awesome power into our hands, which can be used to enhance the well-being of mankind by multiplying enormously our ability to produce goods and services – or it can be used for destruction on a scale threatening the extinction of the human race. The question of whether man is to be master of, or mastered by, his machines has been asked before; apparently the time is fast approaching when it must be answered.

This is not going to be an easy task, and we shall certainly fail unless we keep in plain sight one vital factor: namely, that technology is a means and not an end. There has been plenty of exhortation over the last several months about the need for preserving our leadership in science and technology. No one will seriously quarrel with this objective, but some clarification of purpose would be helpful. Technology can serve a variety of ends, both good and bad. It can raise standards of living and help to promote a fuller life for the individual; it can also be used to oppress peoples who are less well equipped. If we have and intend to preserve a technological superiority, we have also to decide what use we wish to make of it. It is meaningless to demand that we stay ahead in the technological race merely for the sake of being ahead. And if we are wise, we will consider our aims in the light of experience.

Here in the United States we have a society in which the fruits of technology are more extensively utilized and more widely distributed than anywhere else in the world. It is not a perfect society, but then no human society ever has been perfect, and ours has at least the great merit of having made possible a higher standard of living for a larger proportion of its people than any other that the world has seen. This is a feat which cannot be written off to historical accident or sheer luck. We have been well endowed with natural resources but other parts of the earth are just as rich. Russia has more territory than we have, China has more people, and either one has at least as much potential wealth. We have just been

made acutely aware that we have no monopoly on talent. In short, the explanation for the American achievement has to be sought elsewhere, and the obvious place to look is in the record of our own past.

The United States began as what is now euphemistically termed an "underdeveloped area," and its people had to do their own developing. European capital and technical skill contributed much to our economic growth, but it did so on a business basis, in the expectation of getting a return. This situation was all to the good. The American people were thrown on their own resources and ingenuity, and they found the key to progress in a social order which provided freedom for creative ability to find its own outlets. In the area of technology, the person with an idea for a new product, or a better way of making an existing product, was free to go ahead and try.

He might not succeed. We frequently forget that the "unalienable right" listed in the Declaration of Independence is the "pursuit of happiness"; there is no guarantee that we will catch it. Nevertheless, if we take a few names at random – Colt, Ford, Edison, Kettering, Whitney, Westinghouse – it is clear that the man with ideas and the ability to implement them has found ample opportunity in the American environment, and this freedom of opportunity is the vital ingredient in our economic achievements.

There are those who claim that these opportunities no longer exist in an era of great corporations and organized research. The growth of electronics in the last 10 years might be sufficient refutation, but there is more to be said. However much business organization may have changed, it has never reached the point of having a surplus of competent leadership and creative talent. The individual who possesses these qualities is still reasonably certain of being given every chance to display them.

If we wish to maintain this freedom of enterprise we had better recognize that it is an extraordinarily difficult thing to do. Making a free society function calls for endless patience, willingness to compromise, and acceptance of human perversity and weakness as facts that have to be lived with. Furthermore, an industrial civilization is a highly complicated mechanism, which requires a greater degree of regulation by governmental authority than the simpler economies of the past – with the attendant risk, human nature being what it is, that the itch to regulate will feed on itself and get out of control.

This, in fact, is where the greatest danger to our free society lies. Very few Americans would consciously choose to replace our way of life with the brutal tyranny of communism, yet we can drift into something very like it without realizing what we are doing. We might do it from panic. We are, for example, quite properly concerned about deficiencies in American education, but it does not follow that the remedy is to rush blindly into adoption of Russion educational methods simply because the Russians may be turning out more scientists and engineers than we are. Apart from the fact that the Russian educational system also has its flaws,* there is still

*Alexander G. Korol, *Soviet Education for Science and Technology* (New York: The Technology Press of M.I.T. and John Wiley and Sons, Inc., 1957).

M.I.T. Photo

The most distinctive and greatest American contribution to technology has been mass production and the concept that benefits of technological progress should be passed along in the form of higher incomes and lower prices.

the important element of purpose: before we go in for the mass production of scientists and engineers, we might take time to consider what kind of scientists and engineers will make the most effective contribution to the way of life which we hope to maintain in the free world.

Soviet technology has made some spectacular achievements, for which it is entitled to full credit. There is no evidence, however, that it is doing the Russian people much good, or that it is likely to in the foreseeable future. Technology has no built-in mechanism for distributing the wealth it creates; the decisions on how this is to be done have to be made by human agencies. In the collective society, this agency is an omniscient (in its own eyes) planning authority. When it makes mistakes – as it frequently does, infallibility being a divine and not a human attribute – the people pay the penalty. They go without. The American method is less orderly on paper and infinitely better in practice. Decisions on production and distribution are ordinarily made by that much-abused character, the businessman. If he guesses wrong, somebody else gets his customers – but the goods still get produced.

Yet the social planners are with us too, and they are certain to use the technological crisis as an argument for further restriction of private enterprise. We will be told that science and technology have created a situation so novel that we have no option but to entrust our destinies to the bright boys who know all the answers. It will, of course, be couched in more high-sounding terms. Not so long ago the selling point was a lot of fine talk about human rights being more important than property rights – this despite an impressive volume of evidence from history demonstrating that the right to ownership of what one has earned is among the most fundamental of all human rights. Even without going into history, the world about us provides plenty of examples to show that where property rights are set aside, where the sanctity of contracts is disregarded, other rights are treated casually also. A government which can justify the confiscation of property by calling it na-

(*Continued on page 416*)

Precious Commonplace

All forms of life depend upon a natural resource that is useful only when in the right place at the right time in a sufficiently pure state. Yet man is prodigal of water

by **FREDERIC W. NORDSIEK**

WATER, one of the most abundant substances on earth, is a precious natural resource that presents a paradox. The world's stores of water are virtually indestructible; yet mankind is as prodigal of this resource as he is of forests, coal, petroleum, and other natural gifts. Man wastes water by displacing it and by polluting it; for water is useful only when it is in the right place at the right time, and in a suitable state of purity.

About 30 inches of rain have, on the average, fallen upon the United States every year since the Weather Bureau of the federal government began to accumulate these data in 1870. Unfortunately this rainfall is not uniformly spread across the country; some areas are parched, while others struggle against flash floods, erosion, and such consequences of too much water.

Some 70 per cent or more of the limpid gift of rainfall is immediately pre-empted by living plants, and returned by them directly to the atmosphere. But still enough water remains, if properly handled and equitably distributed, to more than satisfy America's Gargantuan appetites for this fluid. For the citizens of this country are pre-eminently the water gluttons of the world; this is not a term of opprobrium, for it reflects cleanly personal habits, high standards of living, and a mammoth industrial development. Domestic sewage in this country is much more dilute than in Europe, because Americans take many baths, and enjoy water-greedy home appliances, such as automatic garbage disposal units that flush refuse down the drain, dishwashing machines, clothes washers, and air-conditioning equipment. The citizens of Chicago – most lavish water users of all United States big-city residents – consume water at the extraordinary rate of 229 gallons per person per day. American industry gulps down 95 billion gallons of water each year. A still larger user of water – just how much larger is not precisely known – is irrigation for agricultural purposes.

But the engineering and conservation aspects of water cannot be covered adequately here; the foregoing comments were set down mainly to show the global importance of water, and to paint a backdrop against which to depict the biological significance of this substance.

Living Water

Aside from their need for oxygen, the most pressing demand of animals and plants living today is their requirement for water. This need is scarcely surprising when we acknowledge that water constitutes from about 60 per cent to about 99 per cent of protoplasm, the living juice of all plant and animal cells. Water is useful biologically for much the same reason that it is valuable domestically and industrially; it is the universal solvent. This means that water can dissolve and carry in solution a greater variety of gases, liquids, and solids than can any other fluid.

Animals and plants dwelling in oceans, lakes, ponds, rivers, and brooks obtain their oxygen from the waters that surround them, where it is available abundantly in solution – unless man has wantonly polluted the water with oxygen pre-empting waste materials. Land-dwelling plants and animals take their oxygen directly from the air. But within the tissues of all plants, and of all animals – except those whose blood contains an oxygen-transporting pigment, such as the hemoglobin in mammalian blood – water again performs its oxygen-bearing function. Oxygen in water solution is brought to every living cell, where it is used for the oxidative processes of metabolism that sustain life. In the same way, nutrients in aqueous solution are borne by the body fluids from the organs of digestion or absorption to each individual cell; then waste materials are dissolved from the cells and carried away to the organs of excretion.

Circulating body fluids also carry in water solution hormones, the so-called "chemical messengers," that are produced by the ductless glands, such as the pituitary, thyroid, adrenals, sex glands, and others. Hormones often do their work at locations in the body far away from the glands where they are produced. In fact, hormones are only slightly less important than the nervous system in effecting necessary co-ordination of functions within the animal body, and they accomplish this co-ordinating task by traveling through the body in aqueous solution.

Water, in the circulating fluids of living things, not only transports materials for the complex chemical reactions fundamental to life, but also makes these very reactions possible by providing the necessary aqueous environment. As students learn early in high school chemistry, common chemical reactions usually will not proceed while the reagents are in the dry state. Witness baking powder, which is stable so long as dry, but which erupts into violent reactions as soon as it is moistened. A biological example is the seed, which remains dormant while it is dry, even if all other conditions are optimal for sprouting; but once water is supplied, seeds spring into active life.

Hot and Cold

Water is the ultimate agent that enables man and other mammals to maintain a uniform internal temperature; and this man must do or he perishes. Ordinarily, the human body temperature has an extreme diurnal fluctuation of but two degrees Fahrenheit, regardless of whether the environment is hot, cold, or temperate. If man, like fishes, amphibians, and reptiles matched his internal temperature to ambient temperatures, he probably would not have achieved his present highly developed civilization, which has been gained by steady year-round mental and physical activity regardless of the season of the year or location upon the earth; for animals with variable internal temperatures become sluggish or totally dormant when exposed to cold.

Heat within the body is generated by the cellular oxidation of food substances and by muscular activity. It is dissipated from the surfaces of the body and respiratory passages, in part by radiation and convection but mainly through the evaporation of water. For each thousand kilogram calories disposed of by this latter method, the body must evaporate nearly two quarts of water. Evaporation of moisture in the breathing passages disposes of about one-tenth of the human body's surplus heat. Most of the remainder is taken care of, in the human being, by evaporation of sweat from the skin, and, in furry animals – (like the dog) that do not have sweat glands in the skin – by evaporation of moisture from the tongue and respiratory passages. The dog facilitates this cooling process by "hyperventilation," that is, by panting, to increase the flow of air through the mouth, across the tongue, and through the respiratory passages.

Thus water gets the credit for keeping the mammalian body cool enough internally; and this is the main problem in maintenance of uniform temperature. Other body mechanics, that need not be elaborated upon here, are charged with the simpler task of making sure that internal temperatures do not fall too low. Water, within the bodies of lower forms of life that do not enjoy the automatic temperature regulating mechanisms of the human body, also serves a sort of temperature stabilizing function, for water can absorb more heat with less change in temperature than almost any other known substance.

Good Taste

A function of water that has much hedonistic significance and perhaps some physiological value is its role in the tastes of foods. Only substances soluble in water can be tasted. Here we are talking of *taste*

Hot Weather Antidote — *Albert E. Graf*

in the true and fundamental sense, comprising only the sensations of sweet, sour, salty, and bitter. Many flavors, for example vanilla, are really odors; and a substance need not be water soluble to produce this sort of flavor sensation. But true tastes come to the human being only in water solution; for example, sour tastes from hydrogen ions; salty tastes from salts of low molecular weight; bitter tastes from salts of high molecular weight; sweet tastes from substances as dissimilar chemically as sugar and sacharin.

Private Ponds

Evolutionists hold in general that terrestrial forms of life evolved from forms dwelling in the ocean. Confirmation of this idea comes from the fact that the body fluids of the higher animals, including man, contain the same inorganic substances, in the same proportions, as does sea water. In fact, the higher animals have never escaped completely from an aqueous environment. Amphibians, one evolutionary notch above the fishes, spend part of their time on land; but their eggs usually are laid and their young hatched and nurtured in water. Turtles, which many believe another step higher on the evolutionary ladder, lay eggs on land. But the interior of turtle eggs provides a watery environment for the embryo, much like the one in which amphibian embryos develop.

Considering now the most highly evolved animals, the mammals including man himself, we learn that amniotic fluid in the mammalian uterus provides a watery environment quite similar to that enjoyed by embryos of the lower vertebrates. Apparently such an environment is ideal for the critical period of embryonic development. Thus perhaps we may say that when marine animals invaded land, probably in the Cambrian period of geological time nearly 500,000,000 years ago, they brought along with them private ponds in which their young might develop.

How Dry I Am

The basic needs of the human body, in order of exigency, are air, water, and food. Suffocate a man, and he perishes quickly. He can survive for long periods of time without food, often 30 days or more, living off his body reserves. He cannot go without water for nearly so long. Castaways traditionally have been troubled much more by thirst than by hunger. Even in the minute-to-minute terms of regular everyday existence, we need water much more often than we need food. Ordinarily we eat about three times a day; but water coolers and drinking fountains are found everywhere, and everyone makes frequent use of them. The dispensing of carbonated beverages, fruit juices, and other drinks – consisting largely of water – is big business; so big indeed that in recent times it has had to be turned over more and more to slot machines. The human stomach keeps pace with these relative needs; it passes imbibed water along to the intestines in about 10 minutes, but takes four or five hours to empty itself of the food of a meal.

The dog resembles man in the relative urgency of its needs for food and water; but quite the reverse is true of some of the smaller mammals. The common laboratory rat, for example, survives about 13 days with food and no water, but only about eight and a half days with water and no food.

Another rodent, the kangaroo rat of the Arizona deserts, does entirely without water. This engaging looking little beast resembles a miniature kangaroo, and jumps just like a kangaroo. It has large appealing eyes – evidence of its nocturnal habits. This rodent eats dry seeds and other dry plant materials, and never drinks water; in fact, no water is found in the deserts it inhabits.

The seeds this creature consumes give it a bit of water; about 5 per cent of this food is moisture (many human foods, in contrast, contain 90 per cent water and more). Also, the internal metabolism of the beast, like that of all mammals, yields some water; the kangaroo rat generates internally 0.6 gram of water from each liter of oxygen metabolized. This minuscule amount of water would never keep the rat alive, did not the animal have special means for preventing loss of water from its body. Sweating is minimized because the rats stay in their cool burrows during the scorching desert days. These same underground burrows also help the rats minimize the water loss from their respiratory tracts; the relative humidity in their burrows is usually some 50 per cent, whereas outdoors the Arizona desert air has relative humidities of less than 15 per cent.

The kangaroo rats lose very little water in their excrement. From each 100 grams of seeds eaten, they produce about five grams of feces, containing less than two and a half grams of water. These animals also excrete a remarkably concentrated urine. The most concentrated human urine contains some 2.2 per cent electrolytes and 6 per cent urea; but kangaroo rat urine contains about 7 per cent electrolytes and 23 per cent urea. If man could perform this extraordinary physiological feat, he could thrive while drinking sea water (as the kangaroo rat has been shown experimentally to be capable of doing), and human castaways upon the ocean would not need to suffer the ordeals of water deprivation they now sometimes undergo. More will be said presently about the question of imbibition of sea water by human beings.

The studies of the kangaroo rat just summarized represent basic research – pursuit of knowledge for its own sake. But similar research on the camel, recently conducted in the Sahara Desert (where temperatures sometimes go as high as 140 degrees F.) by the United Nations Educational, Scientific, and Cultural Organization, with joint sponsorship by other private and governmental agencies, was highly practical; for the camel is the beast of burden of extensive hot, dry areas of the earth.

Ships of the Desert

Contrary to popularly held ideas, the camel does not store water in its hump or in its several stomachs. It can, nevertheless, thrive without water to drink for weeks at a time. The UNESCO study being cited showed that the camel does this by means similar to

(*Continued on page 422*)

America's Many Battles with Cholera

The conquest of cholera in the United States is mainly, although not entirely, a triumph of sanitary engineering

by JAMES A. TOBEY

ONCE upon a time cholera was a word to conjure with in this country. Now, however, it is one of a substantial number of potent maladies that have completely or almost completely disappeared from the American scene. Among the other serious and lethal diseases which once were rife in the United States but now may be classed as obsolete here, if not elsewhere, are smallpox, yellow fever, and bubonic plague. Those which are now so rare as to be regarded as obsolescent in this country include typhoid fever, typhus fever, hookworm disease, trachoma, malaria, diphtheria, goiter, and pellagra; these last two are dietary deficiency states and not communicable diseases like all the others listed. At one time or another, all of these maladies have been rampant in North America.

Although the name cholera is virtually unknown to the last two generations of Americans (and has been more or less forgotten by the others), this disease has been characterized as America's greatest scourge. In the course of a little more than half a century, from 1832 to 1892, it swept across the nation in half a dozen tremendous epidemics, creating havoc everywhere and taking a high toll of valuable lives. Actually, these waves of cholera epidemics were no worse than the smallpox outbreaks and the visitations of the terrible "throat distemper," or diptheria, in colonial days in America, or the ravages of yellow fever in the middle of the Nineteenth Century which took even more victims, but were no more terrifying, than the "Indian pestilence."*

Cholera was aptly known as the "Indian pestilence," or Cholera Indica, or more commonly as the Asiatic cholera, because it came out of the East, particularly from India, where it had flourished for centuries and is still highly prevalent. The great antiquity of the disease is indicated by references to it in the most venerable of Sanskrit documents, and also by an accurate description of it written by a Portuguese physician in Goa, one Garcia del Huerto, in 1563. The malady was, however, unknown in Europe until the beginning of the Nineteenth Century, when India was opened up to trade with the West.

Asiatic cholera itself is a disease of sudden onset and rapid action, with violent purging, the so-called "rice water" stools, vomiting, cramps, and collapse, with death ensuing often in from six to 48 hours. The mortality is relatively high, averaging about 10 per cent of the cases, but sometimes going as high as 50 per cent. The terms "cholera infantum" and "cholera morbus," which were in vogue a few generations ago, were applied to other diarrheal conditions and not to true cholera, while the ailment of swine known as hog cholera is something else again and, like chicken cholera, has no connection with human cases.

* James A. Tobey, "Yellow Fever's Role in History," The Technology Review, 56:145 (January, 1954); "When Smallpox Flourished in America," 58:97 (December, 1956).

The First Great Epidemic

In 1817 the Asiatic cholera, which was raging in Jessore in India, broke out of its bounds and was carried by ships to Malay, to China and Persia, and finally to Russia, where it flourished among the susceptible peasants for a decade. From there it spread to Poland and then on to Germany, France, and England, where the disease caused disastrous epidemics in 1831 and 1832. In 1831 there was also a tremendous epidemic of cholera among the Mohammedan pilgrims to Mecca, where it is said that 20,000 out of some 50,000 of the devout hadji perished from the disease. Until very recent times these Meccan pilgrimages always have been fertile sources of infection.

The great pandemic of 1832 was not long in reaching the Americas, for this was the period when clipper ships and packets were constantly making the long voyage of from 36 to 60 days across the stormy Atlantic, bringing immigrants from Ireland, Germany, and other parts of Europe to the promised land. Too many, unfortunately, never arrived. On each of these ships 150 to 200 passengers would be crammed into the fetid, stinking holds where the sanitary arrangements were primitive, and conditions were favorable for the rapid spread of disease. In this year, four ships bound for Quebec lost 101 of 700 passengers from cholera en route.

The *Carrick*, a brig from Dublin, is blamed, however, for the introduction of the Indian pestilence into the Americas. After burying, at sea, 42 of its original 145 passengers who had succumbed to cholera, this ship arrived at Grosse Isle below Quebec on June 3 1832. The survivors, many of them sick, were transferred to a small, overcrowded river steamer, the *Voyageur*, for the trip to Quebec, where they arrived on June 8. On the way, a feather bed upon which a cholera patient had died was cast overboard, floated ashore, and was salvaged by a settler, who promptly came down with cholera and died of it.

By the middle of June, the city of Quebec was in the throes of a full-blown epidemic of the Asiatic

cholera, with some 500 cases a day. Before this panic-causing outbreak had subsided, it had been responsible for 2,218 deaths here, and about half as many in Montreal. From Canada the disease traveled along the newly opened Erie Canal to Albany, and then down the Hudson to New York City, although some authorities thought that it had already entered by the port there. At any rate, cholera caused about 3,500 deaths in New York City. At Sing Sing Prison, up the river, 175 out of 1,000 inmates were infected, and 73 (a high percentage) died. The disease then went on to Philadelphia and Baltimore, and from there to the entire Interior Valley of the country. It coursed down the Mississippi, with fatal stops at Vicksburg and Natchez, to New Orleans, where an epidemic of yellow fever also was raging. In this city more than 6,000 persons are reported to have lost their lives. The epidemic crossed the Caribbean to Havana, killing a reported 15,000 there, and was likewise rampant in Mexico. All in all, it was a most devastating episode.

Troops moving from the East to Illinois to participate in the war against the Indian chief, Black Hawk, carried the infection to Ohio, Illinois, and Michigan. Of 200 soldiers who started out under General Winfield Scott, 62 – including two medical officers – died of cholera on the way, 51 were sick on arrival at Fort Dearborn, and only about 80 were fit for duty. Among the participants in this Black Hawk war was a young captain of Illinois volunteers named Abraham Lincoln, who saw no action and afterwards wrote that all he learned in this campaign was to look after the health of his men. Many years later, in his second inaugural address, President Lincoln made the much-quoted remark that, "We can not escape from history," an adage which certainly applies to the history of epidemics in this country.

At this time no one regarded cholera as a contagious disease, but as one caused by effluvia and noxious vapors. In order to dispel these miasms and purify the air, artillery was fired at sunrise, and bonfires of tar and pitch belched black smoke during the day. The doctors treated their cases with hearty doses of calomel and opium, profusely bled their dehydrated and anemic patients, and advised against the consumption of such laxative foods as gooseberries, apples, pears, green corn, cucumbers, and whortleberries. The most eminent physician in Cincinnati, Dr. Daniel Drake, declared that the cholera was due to damp air and was fostered by individual excitement. He assured the public that the pestilential cloud would soon pass away and urged them to be calm. Despite this assurance, the epidemic continued, as no one thought to advocate the boiling of the drinking water.

Another curious remedy of the times was the Cholera belt, a flannel binder which was placed around the abdomen and was supposed to ward off the disease. These cummerbunds were so highly regarded that they were standard equipment for soldiers almost up to the time of World War I.

After ravaging the entire country and using up its quota of susceptibles, the cholera epidemic of 1832 finally subsided, except for sporadic cases. In 1849 after a terrible epidemic of the disease in Calcutta and other parts of India, it returned to the United States, brought by some or many of the swarm of 300,000 immigrants who flowed into the Americas that year. Like the earlier outbreak, this epidemic swept over the country; it followed the Gold Rush to California, bothered the Mormons on their hegira to the West, and among numerous other famous victims, caused the death of Robert S. Todd, father of Mary Todd Lincoln. On the whole, the carnage was about as great as it had been 16 years earlier.

Dr. Snow and the Broad Street Pump

Our third great visitation of cholera occurred in 1852 and 1853, and was imported as usual from the East via Europe. In the latter year, 28 ships bound for New York buried at sea 1,141 victims of cholera, but brought in many sick to spread the seeds of the infection. This was also the year which marked the beginning of the Crimean War, in which more than twice as many of the troops died of cholera and other diseases as were killed in battle, including the Charge of the Light Brigade. This war was, however, notable for the sanitary advances instituted by Florence Nightingale – the "Lady With a Lamp" – who was the founder of modern nursing.

When cholera was raging in London at this time, an inquisitive physician and sanitarian, named John Snow, observed that the death rate from the disease was unduly high in one particular parish, that of St. James. By a brilliant piece of sanitary detective work, a landmark in the history of epidemiology, he demonstrated that an unusual number of cases occurred among persons who imbibed of the well water from the popular Broad Street pump. He then established the fact that sewage from an adjacent house (where a case of cholera had been reported) was finding its way directly into this well. Those who consumed this water, including individuals who came long distances to get it, became sick, while those who drank waters from other less-favored wells remained healthy. Thus, it was proven that cholera was indeed a communicable disease and that it was spread by polluted water, among other ways.

This noteworthy demonstration knocked the miasmatic theory of cholera into a cocked hat and showed that proper sanitation could prevent what had formerly been considered to be an unpreventable disease. This startling idea was put into practice in Germany by an able young physician named Max Joseph Von Pettenkofer, who proceeded to reduce cholera in his native Hamburg by sanitary means.

Despite this new knowledge, cholera returned to America in full force in 1866. Of 8,500 passengers and crews arriving by ship in New York Harbor in that year, 872 died of cholera. In the city itself, there were about 1,200 deaths from this cause, with another 800 or so in the separate city of Brooklyn. This epidemic, like all the others, spread throughout the country, causing an estimated 50,000 to 60,000 deaths, although no one knows precisely how many in those days of meager vital statistics. During the Civil War which had just ended, disease had accounted for about two and a half times as many deaths among the troops as had bullets.

(*Concluded on page 416*)

BUSINESS IN MOTION

To our Colleagues in American Business . . .

Under today's competitive conditions, a manufacturer can't afford to take anything for granted. He continually seeks to improve even the so-called "perfect" product and to reduce production costs.

One such progressive manufacturer, in reviewing the materials and processes used in making their spherical roller bearing cages, sought the opinion of others. One of those "others" was Revere's Technical Advisory Service, which was called in to review the kind of brass that was being used in the cages and to study the problem first-hand. This meant consulting with the engineering department as well as observing the manner in which the bearing cages were being produced.

After a careful study recommendations were made. The result was the adoption of specification changes in the brass strip used which, in addition to improving the quality of their roller bearing cages, gave this manufacturer the following money-saving advantages: One bore pressing operation has been eliminated. Machining is more easily accomplished. Less machining is required. Tool life has been increased with some speeds increased up to 100% and feeds up to 30%. Rework due to burrs has been greatly reduced. One step less is required in the deburring operation while savings through reduced cycle time for remaining deburring operations are up to 40%. Chips are small now . . . there is no "angel hair" to clutter work area. Life of punch used in notching roller bearing cage has been doubled. Now a run may be completed without making tool adjustments due to sharpening tools. Machining speeds and feeds have been substantially increased over those in machining the former alloy. Die setters report that considerable work has been eliminated in setting up the tools used. All of which resulted in substantial savings in time and money.

This is still another eye-opening example of Revere supplying the metal that will do the best job and with the greatest economy . . . be it brass, copper or aluminum or any one of their alloys. It is also another example of the many advantages of working closely with *your* supplier, whether it be through Purchasing, Production, Engineering or Design Departments, separately or collectively. It is one sound way to go about lowering production costs, improving manufacturing techniques and bettering *your* product.

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

***Executive Offices:* 230 Park Avenue, New York 17, N. Y.**

BATTLES WITH CHOLERA

(*Concluded from page 414*)

The next great epidemic of cholera hit the United States in 1873, coming from Central Asia by way of Russia and Europe. In Hungary alone, there were said to have been half a million cases, although these figures probably are exaggerated. This outbreak began here in New Orleans and promptly traveled up Old Man River to the entire Interior Valley. The epidemic was worse in the small towns and rural communities than in the larger cities – some of which were beginning to get decent water supplies. In Tennessee, one of those stricken was ex-President Andrew Johnson, but he recovered. In this year Dr. William Budd in England issued a brilliant report on typhoid fever, showing that it, like cholera, was a water-borne disease.

The Cholera Germ

During this era, a chemist in France – Louis Pasteur – had been demonstrating that many human diseases are caused by specific micro-organisms, and that methods of immunity could be developed against them. His earliest work in this field was concerned with anthrax and rabies. This founding of the germ theory of disease from 1865 to 1875 led to the discovery, during the 1870's, of the causative organisms of a number of diseases, but it was not until 1884 that the cholera germ was found. A severe outbreak of this malady in and around Cairo in 1883 had brought a mission from Pasteur's laboratory in Paris; and Pasteur's great rival in the new science of bacteriology, Dr. Robert Koch of Germany, who had discovered the bacillus of tuberculosis in 1882, also went to Cairo to study the disease.

This investigation cost the life of one of Pasteur's valued associates, Thullier, who contracted cholera in Alexandria and died of it. Dr. Koch was successful, finding in cholera patients a distinctive organism which came to be known as the "comma bacillus" because of its peculiar shape. Actually the organism was not a bacillus at all, but a rod-like organism called a spirillum, and now scientifically known as the *vibrio cholerae*. A few years later, in 1893, Dr. Waldemar M. W. Haffkine in India prepared a vaccine from it, which has since been improved. In World War II this vaccine was given to all American soldiers who were sent to cholera-infested localities. None got the disease.

The epidemic of 1884 ravaged Europe for several years. It produced some 17,000 cases in Hamburg alone, and eventually reached the United States in 1892, coming in through New York. By now, however, the public health officers knew how to cope with cholera, and this outbreak was pretty well nipped in the bud. It was the last substantial epidemic of cholera in this country, although cases were reported as late as 1911, in Brooklyn and elsewhere.

Although cholera has been absent from the American scene for nearly half a century, it is rampant in many other parts of the world, particularly in Asia. From 1945 to 1949 cholera caused more than 800,000 deaths in India and Pakistan alone, but in the next five years caused less than half as many deaths. The record is still bad, but there is progress. After World War II, a severe epidemic of cholera broke out in Cairo in 1947 but with help from outside was brought under control.

The conquest of cholera and of other water-borne diseases in this country is mainly, but not exclusively, a triumph of sanitary engineering. Since 1886, when the late Professor William T. Sedgwick of M.I.T. began his studies on water and sewage at the Lawrence Scientific Station in Massachusetts, our engineers have developed, installed, and maintained effective methods for pure and potable water supplies, and for the safe disposal of sewage and other human wastes. Through these and other aspects of environmental sanitation, the knell was sounded for cholera, typhoid fever, dysentery, and many other dangerous communicable diseases.

TECHNOLOGY IN A FREE SOCIETY

(*Continued from page 409*)

tionalization will have no trouble justifying encroachments on the liberties of its own people.

This alleged conflict between property and human rights also leads to the assumption that the government ought to supervise the distribution of the national income in order to remedy inequities. Admittedly public authority must be used to protect the weak, to give some security against the unavoidable hazards of an industrial economy, and to provide equality of opportunity. This is not the same thing as the philosophy of consciously adjusting the tax structure, giving subsidies to special groups, controlling prices and wages, and in general using the power of government to arrive at some vaguely defined notion of "social justice." (Some of the vagueness may be intentional; if the social planners know where they are going, they prefer not to reveal it to the rest of us.) In its simplest form this philosophy holds that any problem can be solved by spending enough of the taxpayers' money. If one billion doesn't work, try two – or better still, ten.

It is not a new idea; the Roman Empire had its bread and circuses. Nothing in history suggests that a healthy society can exist if people are conditioned to take it for granted that the government will settle all their problems for them. In the end – as happened in Imperial Rome – the productive members of society are bled white to support the unproductive, and economic and technical progress die of suffocation beneath the tax burden.

History is littered with the wreckage of "share-the-wealth" schemes, all overlooking the vital point that if the incentive to produce is destroyed, there is not going to be any wealth to share. This incentive has always been best provided by freedom of enterprise – by capitalism, a word that we have quite needlessly allowed ourselves to become ashamed of.

American capitalism, furthermore, has worked out its own rather effective share-the-wealth system. The most distinctive and the greatest American contribution to technology has been mass production. It is more than just a technological achievement; mass production rests on one concept which seems ele-

(*Concluded on page 418*)

CHECK POINTS FOR CHOOSING AN ENGINEERING FIRM—

PICK ONE WITH EXTENSIVE PROCESS INDUSTRY EXPERIENCE

Choose a firm with a staff and facilities geared to the design, engineering and construction of chemical and petrochemical plants —and with a *proven* record in this area of industry.

The Lummus Company, for example, has built over 800 chemical process units in the last 50 years. Among them have been the world's largest butadiene plant, the world's first commercial plant to make high-pressure acetylene chemicals, and one of the least expensive anhydrous ammonia plants ever built.

Lummus maintains a staff of highly trained specialists in seven branch offices and subsidiaries throughout the world. They are thoroughly experienced in chemical plant design and construction.

Then, too, Lummus has an Engineering Development Center to bridge the gap between laboratory research and commercial plant operation. The Center has extensive chemical pilot plant facilities in operation, and is equipped for designing and building new pilot units.

Call in Lummus when you begin plans on your next chemical plant.

CHEMICAL PLANTS— A SPECIALTY OF LUMMUS

ABOVE — World's first full-scale, high-pressure acetylene chemicals plant at Calvert City — engineered and constructed by Lummus for General Aniline & Film Corporation.

BELOW—Just a few examples from Lummus' long list of outstanding chemical projects.

PRODUCT	COMPANY	LOCATION
Vinyl Acetate	Air Reduction Chemical Co.	Calvert City, Kentucky
Phenol-Acetone	Progil-Electrochimie	Pont de Claix, France
Anhydrous Ammonia	Food Machinery & Chemical Corp. (Westvaco Chlor-Alkali Division)	South Charleston, West Virginia
Phthalic Anhydride	Pittsburgh Coke & Chemical Co.	Neville Island, Pa.
Epon Resins	Shell Chemical Corp.	Houston, Texas
Bisphenol	Shell Chemical Corp.	Houston, Texas
Tetramer, Cumene, Phenol-Acetone	Societe des Chimiques des Derives du Petrole	Antwerp, Belgium
Sulfuric Acid	Inland Chemicals Canada Ltd.	Fort Saskatchewan, Alberta, Canada
Ethylene Oxide-Glycol	Calcasieu Chemical Corp.	Lake Charles, La.
Ethylene	Petroleum Chemicals, Inc.	Lake Charles, La.
Beryllium Metal	The Beryllium Corp.	Ashmore, Pa.

LUMMUS

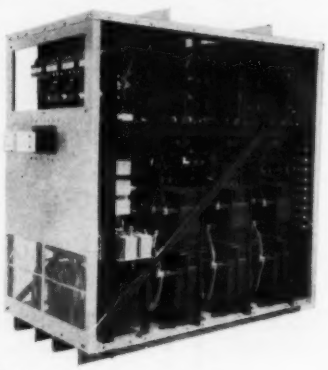
THE LUMMUS COMPANY, 385 MADISON AVENUE, NEW YORK 17, N.Y.

WASHINGTON, D.C. • CHICAGO • HOUSTON • MONTREAL • CARACAS • MARACAIBO • LONDON • PARIS • THE HAGUE

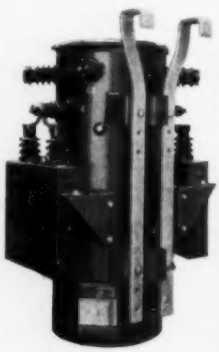
HEVI DUTY

IN STEP
with tomorrow's
stepped-up
DEMANDS

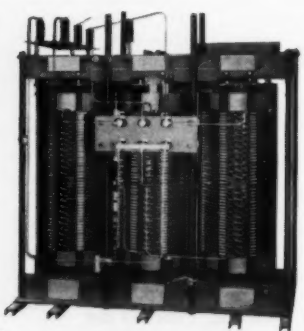
DRY TYPE TRANSFORMERS,
CONSTANT CURRENT REGULATORS
AND SATURABLE REACTORS



CONSTANT CURRENT REGULATOR used in an industrial electrochemical process.



CONSTANT CURRENT REGULATOR for street, subway and airport lighting.



DRY TYPE TRANSFORMER, 300 KVA, for unit substation. Other transformers are available from 5VA to 2000 KVA as well as Saturable Reactors from 25VA to 500 KVA.

HEVI-DUTY ELECTRIC COMPANY

MILWAUKEE 1, WISCONSIN

Harold E. Koch, '22, *President*
Elton E. Staples, '26, *Vice President*
Chester Meyer, '38, *Assistant Secretary*

TECHNOLOGY IN A FREE SOCIETY

(*Concluded from page 416*)

mentary, but which no one else had thought of before – namely, that producers are also consumers, and that the benefits of technological progress should be passed along to them in the form of higher incomes and lower prices. The concept has not been perfectly developed, but it still remains indisputable that in the U. S. (to a far greater extent than anywhere else) such things as automobiles, refrigerators, television sets, and nylon stockings have become utilities for the many rather than luxuries for the few.

This is all to the credit of our economic system, but let us remember that this system is neither self-operating nor self-perpetuating. It will last only as long as it continues to function in such a way as to make it demonstrably superior to any possible alternative. The one thing we cannot afford to do is sit on our past performances. We must be continually on the alert for better ways of doing things, for new products, for improved techniques.

More is needed, however, than scientific and technical skill. The full nature of the task was effectively stated recently by Alfred P. Sloan, Jr., '95:

"Industrial management," he said, "realizes today as never before that, however competent it may be, it can no longer confine itself directly to the production of goods and services. It must accept responsibility for the impact of its decisions, at the policy level, upon society as a whole since these decisions affect the economic progress of the community and its stability. In other words, it must accept its share of responsibility for human progress and make its decisions in terms of industrial statesmanship."

This is a responsibility to which we will have to bring all the wisdom and judgment we can muster, as well as a clear understanding of the kind of society that we are trying to maintain. We will also have to have faith in the inherent strength of a free society, to realize that with all its vexations and its apparent inefficiency, it still comes out best in both moral values and material well-being. There are no short cuts to Utopia – if indeed there is even any Utopia. The avenues which seem to lead there are like the roads that seemed to go around the Hill Difficulty in *Pilgrim's Progress* – they terminate in danger and destruction. It is one of the tragic ironies of our time that the social philosophy which was supposed to bring paradise to the masses has resulted instead in conditions as in the book *1984;* a despotism more terrible than any of its predecessors because it is completely without moral restraint and because it can use the power of technology to engage in the most ruthless oppression the world has ever seen.

The betterment of humanity has not come, and will not come, through ready-made, attractively gift-wrapped panaceas; it has to come from effort and striving. The great gift of the free society is the opportunity to govern our own lives, to make the most of whatever talents God has given us, and to find the satisfactions of work and achievement. If we want to keep this freedom, then when we come to the Hill Difficulty, we must be prepared, like Bunyan's hero, to face it and climb up.

We do not have it for sale *but* we do see it at work in our Trust Department.

Reality makes thoughtful men take steps to develop plans so that their families will not be left without income if they unexpectedly pass on. For many men life insurance is the source of instant capital to provide income and principal.

Our Trust Department has seen at close range the benefits many families have received from thoughtfully planned trusts for which life insurance has been the major source of capital.

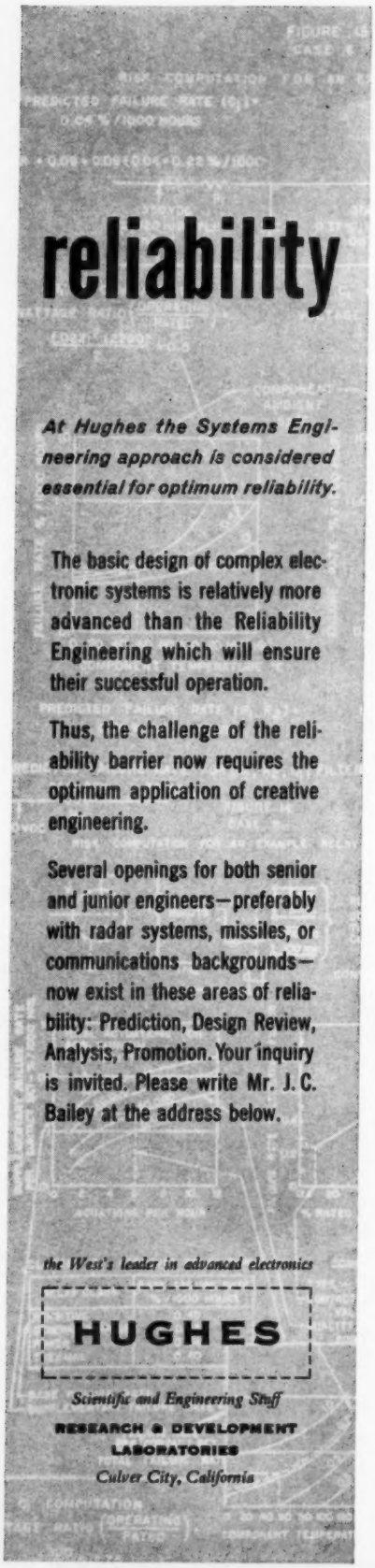
We welcome the opportunity to work with you, your attorney, and life underwriter to develop a plan combining life insurance and other assets with trust management so that you may enjoy the satisfaction of knowing your family has the protection of your own family trust.

The New England Trust Company

135 DEVONSHIRE STREET, BOSTON 7, MASS.
Telephone: HAncock 6-8005
Back Bay Branch: 99 Newbury Street

Member of the Federal Deposit Insurance Corporation

Incorporated 1869


reliability
At Hughes the Systems Engineering approach is considered essential for optimum reliability.
The basic design of complex electronic systems is relatively more advanced than the Reliability Engineering which will ensure their successful operation.
Thus, the challenge of the reliability barrier now requires the optimum application of creative engineering.
Several openings for both senior and junior engineers—preferably with radar systems, missiles, or communications backgrounds—now exist in these areas of reliability: Prediction, Design Review, Analysis, Promotion. Your inquiry is invited. Please write Mr. J. C. Bailey at the address below.
the West's leader in advanced electronics
HUGHES
Scientific and Engineering Staff
RESEARCH & DEVELOPMENT LABORATORIES
Culver City, California

TREND OF AFFAIRS

(*Continued from page 404*)

Visiting Committee Report on Chemical Engineering

■ The Visiting Committee on the Department of Chemical Engineering* met on Sunday, March 2, for the entire day. The Committee reviewed the undergraduate and graduate programs, discussed the status of the practice schools, reviewed the program of the Nuclear Engineering Division, and offers the following conclusions and recommendations:

The Committee endorses with enthusiasm the guided pattern of elective freedom introduced by the Department into its undergraduate program. We recognize that the additional student counseling required by this program imposes added burdens on the staff, but we believe that the results will justify the extra effort.

Professor Walter G. Whitman, '17, Head of the Department, reported on an informal three-day meeting he had held with seven leading chemical engineering educators from other schools. As a result of this meeting there seems little doubt that M.I.T. has maintained its leading position in chemical engineering education, both at the graduate and undergraduate levels. There is, however, some question as to whether the Department is supplying *professional* leadership to the extent expected of an institution of M.I.T.'s general stature. The Committee believes that both facets of the Department's activities are important. We are gratified to note the continued high performance of the Department in meeting its educational responsibilities. We feel, however, that greater emphasis should be given to increasing the research activities of the staff with a view to the publication of basic research in the Department's field of interest. In this way the Department would better fulfill its obligation to maintain its professional, as well as its academic, leadership.

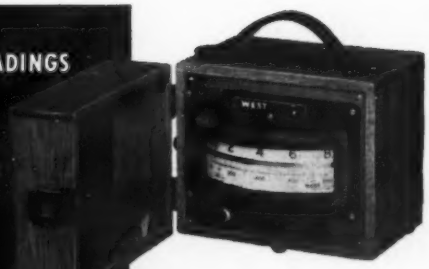
In our review of Nuclear Engineering we note that the M.I.T. reactor is nearly ready for operation. The staff has estimated that the operating cost of the reactor on a three-shift basis would be about $250,000

(*Concluded on page 422*)

*Members of this Committee for 1957-1958 are: Crawford H. Greenewalt, '22, chairman, Fred C. Koch, '22, Clarence L. A. Wynd, '27, Joseph K. Roberts, '28, Lombard Squires, '31, Jerry McAfee, '40, Ward M. Canaday, Clark E. Center, and George F. Getty, 2d.

"Precision-Gauged"
HAIRSPRINGS
More than 25 years' experience making all types of hairsprings for critical instrument applications. High volume production with absolute uniformity.
PRECISION PRODUCTS COMPANY INC OF WALTHAM
WALTHAM 54 • • MASSACHUSETTS

ACCURATE TEMPERATURE READINGS
WHEREVER AND
WHENEVER WITH
Veri-tell
PORTABLE
PYROMETERS BY WEST



These rugged, handy precision-built instruments are widely used for taking spot readings where permanent installations are needless and for checking other instruments. Each mounts a Veri-Tell high resistance pyrometer in a gasketed aluminum housing, itself contained in practical Oak Case with lock and handle. Quick, positive service is assured by binding posts for attaching thermocouple. Automatic meter shunt protects meter when case is closed. Fully *guaranteed* and surprisingly *low priced.* Write for Catalog IE-1.

Many standard and special thermocouple assemblies including hand probes are available to permit reading—

- Surface temperature of dies, etc.
- Temperature of non-ferrous molten metal
- Immersion temperature of hot oil, wax, solder pots, etc.

ASK YOUR DEALER

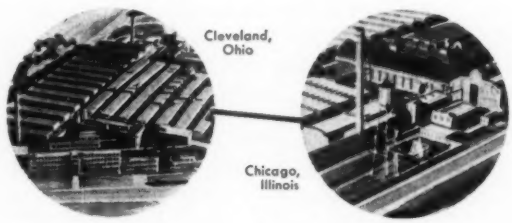
Visit us in Booth 426
4th International
Automation Exposition
June 9-13, 1958, New York

William C. West ('11) Pres.

Canadian Representatives:
Upton, Bradeen & James
English Plant: West Instrument, Ltd.
52 Regent St.
Brighton 1, Sussex

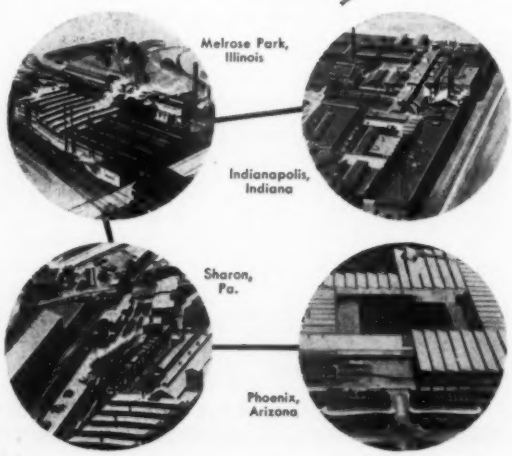
WEST Instrument
CORPORATION
CHICAGO
SALES OFFICES IN PRINCIPAL CITIES

4355C W. Montrose Ave. • Chicago 41, Illinois



National is a "big" company in the sense that it is strong, firmly entrenched as America's leading independent ferrous founder.

HOW BIG SMALL IS NATIONAL?



But National is a "small" company, too. Each of its six large, modern plants is a semi-autonomous operating unit where good men never get "lost in the shuffle." Furthermore, with inter-plant cooperation in sales and production, you are known throughout the company.

For young engineers and business executives on their way up, *National* is the name to remember. Either as a *career opportunity*, or as a *source* for America's finest castings.

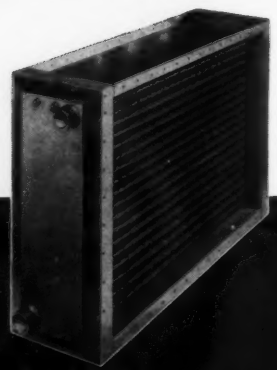
NATIONAL MALLEABLE AND STEEL CASTINGS COMPANY
Established 1868 • Cleveland 6, Ohio

Instron-the tester that stretches dollars

Testing equipment dollars, that is. Here's how: in testing metals, plastics, rubber, textiles, wire, adhesives, and many other materials, the Instron Universal Tester stretches equipment dollars simply because it saves money. And it saves money — *and* time — *and* trouble — simply because it *does* more . . . more accurately. *For facts booklet, write:*

INSTRON
ENGINEERING CORPORATION
2503 Washington St., Canton, Massachusetts

HAROLD HINDMAN '39 II GEORGE S. BURR '41 VIII



MAXIMUM
Heat-Transfer Capacity in Limited Space
•
LOW AIRWAY RESISTANCE

AEROFIN Smooth-Fin
Heat Exchangers

AEROFIN CORPORATION
101 Greenway Ave., Syracuse 3, N.Y.

TREND OF AFFAIRS

(*Concluded from page 420*)

a year. Some support for sponsored research has been promised which might meet one-third to one-fourth of the annual operating cost. The Department seemed concerned with the resulting deficit and was disposed to embark on a promotional campaign which would produce the financial support necessary to defray full operating costs as rapidly as possible.

It is the view of the Visiting Committee that within a very few years there will be an oversupply of worth-while sponsored research for the reactor. We believe that it would be unfortunate if, solely to defray operating expenses, projects were undertaken which were not of the highest scientific merit. We would urge that high standards be set for the work to be done with the reactor and that the M.I.T. Administration be prepared to underwrite deficits in reactor operation until such time as a sufficient number of projects meeting these standards are developed.

PRECIOUS COMMONPLACE

(*Continued from page 412*)

some of those employed by the kangaroo rat, plus other mechanisms. Camels lose little water in their excreta. Camel dung is so dry it is used as fuel by the desert nomads; and mature camels weighing over 500 pounds excrete less than a pint of urine a day, even when drinking all the water they want.

The camel rarely needs water to cool its body by evaporation of sweat, because it prospers with internal temperatures ranging all the way from 93 degrees F. to 104 degrees F. Such an internal temperature fluctuation would prostrate most other mammals. The limit seems to be 104 degrees F., however; when the camel's internal temperature exceeds that mark, it starts to sweat.

Finally, the camel enjoys a unique mechanism whereby it can endure a remarkable degree of dehydration without harm. A man deprived of water until he has lost 10 per cent of his body weight is helpless mentally and physically; a 20 per cent loss is usually fatal. Camels can lose 30 per cent of body weight through dehydration, without even a loss in

(*Continued on page 424*)

SCULLY SIGNAL COMPANY
Safe Fills } with VENTALARM®
No Spills } WHISTLING TANK FILL SIGNAL
for automotive, home and diesel fuel tanks

"JUST FILL 'TIL THE WHISTLE STOPS"

What are your chances of earning $29,712 a year?

Massachusetts Mutual's 100 leading salesmen averaged that amount last year. How did they do it? By making full use of their abilities in a growing and rewarding field: life insurance selling.

IN the 5-year period since 1952, the average annual income of our 100 leading salesmen has increased 62%. *Further*, the 1957 average income of the 615 men with our company five years or more was $12,488, with one in six earning over $20,000.

How does *your* income measure up? And does your present situation offer comparable opportunity for personal growth and income improvement? It could be that a complete change in the course of your career would open the way to full development of your abilities and earning potential.

This is what Massachusetts Mutual offers the man who chooses a career with us: A future that is interesting, challenging and profitable. If you are that man, we will train you for success through outstanding field-tested courses and individual instruction . . . *and pay you while you learn*. Isn't this an opportunity you should investigate?

Take the first step toward unlimited success. Write TODAY for a free copy of "A Selling Career".

Massachusetts Mutual
LIFE INSURANCE COMPANY
SPRINGFIELD, MASSACHUSETTS
The Policyholders' Company

Some of the Eastern Group alumni in Massachusetts Mutual service:

LAFAYETTE
David B. Adler, '17, Jacksonville
M. Holmes Shoemaker,'18, Binghamton
David K. Aldrich, '38, Wilkes-Barre
Frank W. Hiller, '43, Home Office
Benjamin C. Youngman, '44, Pittsburgh

LEHIGH
Wilbur R. Heck, '20, Philadelphia
Russell E. Hoaster, '31, San Antonio
Edward Billstein, Jr., '40, Atlanta
R. Lester Dodson, Jr., '44, New York

M. I. T.
Lyman L. Tremaine, '23, New York
Harold G. Ingraham, Jr., '49, Home Office

U. OF N. H.
Ward N. Boylston, '25, Barre
Ernest W. Furnans, Jr., '37, Home Office
Roger B. Gould, '50, Home Office
Richard W. Vogel, '51, Cleveland
Gerald E. Doten, '55, Home Office

PENN STATE
Rudolph G. Kraft, '18, Home Office
Donald M. Wieland, '19, Wilkes-Barre
Thomas H. Levering, '25, Wilkes-Barre
John L. Macdonald, '28, Wilkes-Barre
Charles P. Kennedy, '32, Chicago
W. Corkran Darlington, '39, Philadelphia
Elizabeth A. Chassey, '55, Home Office
Lawrence F. Hill, Buffalo

FREE BOOKLET TELLS WHAT CO_2 CAN DO FOR YOU

agriculture
chemistry
metals
electronics
refrigeration
food
drugs
textiles
rubber

There's practically no end to the important jobs that CO_2—combined with Liquid Carbonic savvy—is doing. Chances are this combination can come up with some surprising answers for you, too. For scores of CO_2 applications, covering all industry, send for LIQUID's new free booklet, "Applications Unlimited." Just use the coupon below.

MAIL THIS COUPON

LIQUID CARBONIC
DIVISION OF GENERAL DYNAMICS CORPORATION
3100 South Kedzie Avenue, Chicago 23, Illinois

Send me my free copy of "Applications Unlimited."

Name_____
Company_____
Position_____
Address_____
City_____ Zone____ State_____

PRECIOUS COMMONPLACE

(*Continued from page 422*)

vigor. The secret is this; when most mammals are denied water, all of their tissues dry out at about the same rate, but it is dehydration of the blood that first causes disability, then death. But in the camel the normal water content of the blood is maintained, even when the other tissues are markedly dried out.

In the UNESCO camel study, one animal did without water for 17 days, and lost 200 of its original 660 pounds, without any loss in strength and vigor. Then when it was given water, it drank 16 gallons in 10 minutes!

Bottoms Up

Dogs and burros, even when quite dehydrated, usually drink enough water at one filling to replace the deficit. The human being does not do this; usually the drinking of about half of his requirement lends a transient feeling of satiety to a thirsty man; and then, after food and rest, he quaffs enough more to restore to normal the water level in his tissues.

This raises the question: What is thirst? A facile answer would be: a dry mouth. But this answer is inadequate. The drug atropine makes the mouth feel dry without creating a desire for water. The drug pilocarpine produces a profuse flow of saliva in any person's mouth, but does not satisfy the water hunger of dehydrated persons. A man may suddenly become thirsty upon eating a salty anchovy, even though his mouth remains moist. In short, thirst cannot be defined objectively. But this impossibility of definition is no obstacle to either discussion or investigation of the phenomenon, for, in the common cliché, "everybody knows" what thirst means.

Thirst becomes especially meaningful in hot weather, and develops poignant meaning for the man lost on the desert or cast away at sea. It is much pleasanter to starve to death than to die by thirst. Starvation does involve hunger pangs, but otherwise results in a general weakening, apathy, and perhaps final death from an intercurrent infection such as

(*Concluded on page 426*)

A VACATION MESSAGE FROM MOHONK

If you are looking for a *different* type of resort, where it is a *tradition* to provide a relaxed atmosphere and comfortable living, you owe it to yourself to visit the *LAKE MOHONK MOUNTAIN HOUSE*—a famous name in resorts for over 85 years.

Although you are not "pressured" into a continuous round of entertainment, you have a wide choice of activities which include a golf course; tennis courts; "cook-outs"; outdoor movies; a mountain lake for swimming, boating and fishing, which is surrounded by 7,500 acres of private land; miles of roads and paths for horseback and carriage riding; daily prayer and Sunday services are conducted.

There are 300 comfortable rooms. Most rooms have porches and many have fireplaces. American Plan, with generous and tasty meals.

Summer season from May 28 to October 20. For full details, write to "RESERVATIONS," and request rates and booklet IO-4. Mohonk is located about seven miles from New York State Thru-way Interchange No. 18 near New Paltz.

Smiley Brothers, Proprietors
Mohonk Lake, Ulster Co., New York

FACING IMPORTANT BUSINESS DECISIONS?

The decisions you make in business affect not only your company's future, but your own as well. Many business decisions are financial — whether to invest in larger plant facilities, to buy new equipment, to take on more inventory, or any one of hundreds of problems involving financial judgment. At Second Bank-State Street you'll find men who understand your problem, who work together as a team to solve it through modern, creative banking.

Whether your business need is for counseling, contacts, or credit, Second Bank-State Street is ready to put its many useful business services to work for you.

Whatever your banking or trust needs, you're welcome at

SECOND BANK-STATE STREET Trust Company

HEAD OFFICE:
111 FRANKLIN STREET
Richmond 2-4500
Boston, Massachusetts

Member Federal Reserve System • Member Federal Deposit Insurance Corporation

PRECIOUS COMMONPLACE

(*Concluded from page 424*)

pneumonia. But water deprivation causes the following horrendous sequence of events in the human being, as loss of water by evaporation and excretion continue apace.

When some 3 to 5 per cent of the body water has been lost, a man is thirsty and irritable. As the water loss approaches 10 per cent, he develops an apparent lump in his throat that he tries endlessly and futilely to swallow, his facial skin starts to shrink, and he may develop hallucinations. Between a 10 per cent and a 20 per cent water deficit, eyelids stiffen and a blank unblinking stare results, and speech is supplanted by a hoarse bellow or moan. When a 20 per cent water loss is suffered, the skin cracks and oozes blood, bloody tears are wept, and the victim is doomed — even if water is thereupon provided.

Castaways at sea may suffer these tortures though surrounded by the Ancient Mariner's paradox — "Water, water, everywhere, Nor any drop to drink." Has it ever occurred to the reader to wonder why sea water is not a suitable beverage for human use? The explanation revolves around one of the prime functions of water in the body; to flush out metabolic wastes, useless end products of foods, through the kidneys into the urine. As indicated in the foregoing discussion of the kangaroo rat, these urinary wastes are of two broad types; nitrogenous end products of protein metabolism, largely in the form of urea, and various inorganic salts, classed together as electrolytes. Unless these substances are eliminated at an appropriate rate, the animal comes to grief. And every species has a limiting rate at which urea and electrolytes can be eliminated in relation to the amount of water accompanying them; in other words, a limit to how concentrated the urine can be. As previously stated, the maximum concentration of electrolytes in human urine is about 2 per cent. Sea water from the open ocean contains about 3.5 per cent salts. If a man drinks 100 cubic centimeters of such sea water, he needs to excrete 175 cubic centimeters of water in the urine to get rid of the salts thus taken in. Therefore he loses 75 cubic centimeters of water in the deal. Hence castaways who imbibe sea water merely speed up the rate of their dehydration.

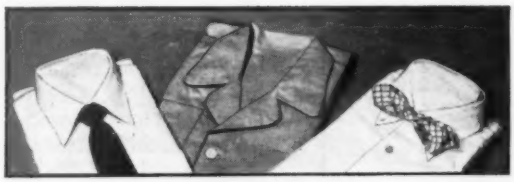
These latter observations point up a principle of a barroom biochemistry, which the present writer proposes be called "The Peanuts, Pretzels, and Potato Chips Principle." Hydration of the human body is not absolute, but relative; relative to the amount of electrolytes present in the body at the moment. As a person consumes salt, he needs to drink an appropriate amount of water to reduce the salts level of his body fluids to normal. And he is impelled to imbibe the requisite water by a sensation of thirst that arises when his body fluids contain more than their normal concentration of salts.

That is why bar proprietors make money by giving away salted peanuts, pretzels, and well-salted potato chips. After all, in such an environment, the only readily available sources of water are beer, highballs, gin and tonic, or similar potables.

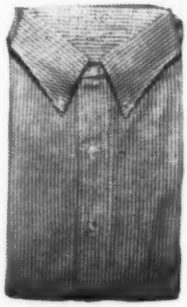
42 sales offices
and 15 factories
give you
fast, dependable
corrugated
box service. Better
see H & D.

HINDE & DAUCH
Division of West Virginia Pulp and Paper Company

SHIRTS



PAJAMAS



THRU JUNE ONLY

Sale

2.98
EACH

Regular Shirt Price 3.90
Regular Pajama Price 3.95*

Dunster St. and Brattle St. . . . The Coop's Own Brands

At regular prices these shirts and pajamas are an extra fine value. At these sales prices they are truly super-values. For many years The Coop has sold them nationally and they receive the hearty approval of customers for long wear, style, fit and for fine quality fabric and tailoring. Use the order form below . . . today!

White or Blue Oxford Shirts . . . Button-Down Collar

White Broadcloth Shirts . . . Regular Collar

Checked Gingham Shirts . . . Button-Down Collar
Red, Black or Brown Checks

Striped Oxford Shirts . . . Button-Down Collar
Back Pleat . . . Collar-Back Button
Blue, Tan or Grey Stripes

Broadcloth Pajamas . . . Coat or Middy Styles
Blue, Tan, Grey or Green
*Extra Large Now 3.98 Regularly 4.95

THE COOP
HARVARD SQUARE
CAMBRIDGE 38
MASS.

☐ CHECK
☐ CHARGE
☐ C.O.D.

COOP NO. .....
(If Member)

Join – Buy – Save
8% or 10% THE COOP

ORDER FORM

IMPORTANT . . . PLEASE NOTE . . . When ordering shirts give quantity, shirt wanted, neck size, sleeve length and color. When ordering pajamas give quantity, style, size and color. Handling and shipping charges: New England states free, other states east of the Mississippi 35 cents per order, states west of the Mississippi 50 cents per order.

.....
.....
.....
.....

NAME · ADDRESS .....
.....
.....

If you are not a member, include $1 for membership so that you will save via the Patronage Refund. 1957-58 Patronage Refund rate is 8% on charge purchases and 10% on cash . . . payable October 13, 1958.

GAS STANDBY

Packaged 12 mcfh plant designed and built by Draketown for...

- ★ Utility or Industrial standby
- ★ Peak shaving and augmentation
- ★ 100% Town or plant supply

A Packaged Draketown Propane Plant will help you reduce demand charges; provide a supply of gas during curtailment periods... at the turn of a valve... or supply that outlying section or plant 100% if desired.

DRAKETOWN PROPANE PLANTS

"Good Gas Insurance"

If you have a gas problem, we can help you. We operate from coast to coast and overseas.

Phone or write today—no obligation.

DRAKE & TOWNSEND INCORPORATED

Consulting • Design • Engineering • Construction

11 WEST 42ND STREET • NEW YORK 36 N. Y.

ATMOSPHERIC EXPLORATIONS

Papers of the Benjamin Franklin Memorial Symposium of the American Academy of Arts and Science

edited by Henry G. Houghton $6.50

LECTURES ON ORDINARY DIFFERENTIAL EQUATIONS

by Witold Hurewicz $5.00

A series of lectures on ordinary differential equations in the real domain, originally given in 1943 by the late professor of mathematics at M.I.T.

THE TAO OF SCIENCE

An Essay on Western Knowledge and Eastern Wisdom

by R. G. H. Siu $4.25

An American scientist with roots in the Orient comments on western philosophy and American educational and business methods.

Published jointly with John Wiley & Sons

Order from

The Technology Press of M. I. T.

Cambridge 39, Mass.

OUR ATOMIC POLICY

(*Continued from page 407*)

I most definitely do not intend to draw from this experience any conclusion about the wisdom of political meetings with the Russians. Remember, the area in which we worked at Geneva was a strictly professional one. It was vital that political considerations be excluded. If they got injected, the conference would be ruined.

However, my experiences before and during the Geneva Conference and my contacts since with people from foreign lands convince me that in able men everywhere there are powerful forces for understanding and co-operation. These forces are latent. They can be brought into play only if men are allowed to have contact with each other, to learn to know each other as human beings and to develop mutual respect. Perhaps the ultimate greatest value of the International Geophysical Year may be as a catalyst for promoting personal contacts and understanding between peoples from all over the world. There are other international activities in which mutual trust and good will can be fostered. I have seen enough of the International Radiation Committee, set up by the United Nations in 1956, to know that the people involved in that international activity are operating professionally, co-operatively, and with trust in each other. The new International Atomic Energy Agency, set up in Vienna last September, provides another really hopeful sign and further opportunity for such contacts. It is most heartening that the Soviets, as well as the United States, have relaxed their restrictions during the past three years to permit a considerably greater intermixing of their citizens and ours.

Reorientation of Thinking

We must reorient our thinking and try to be constructive. The long hostility between Moscow and Washington, in my judgment, overdominates our thinking and our reactions. Perhaps we are in a groove. Is Russia really the biggest problem? Russia has the bomb; we have the bomb; the British have the bomb. In a relatively short time, 15 nations may have the bomb. This would worry Washington, but might it not be equally worrisome to the Kremlin? Really both sides could breathe more freely if there were any assurance that the monopoly of the annihilative potential could be permanently retained

(*Concluded on page 430*)

William H. Coburn & Co.

INVESTMENT COUNSEL

68 Devonshire Street

Boston

BDC 1865 · BDC 1865 · BDC 1865 · BDC 1865 · BDC 1865 · BDC 1865 · BDC 1865 · BDC 1865 · BDC 1865 · BDC 1865 · BDC 1865 · BDC 1865

Boit, Dalton & Church

INSURANCE SINCE 1865

89 BROAD STREET, BOSTON 10 · *Telephone* HUbbard 2-3100

FREDERIC C. CHURCH CHAS. COLBY HEWITT

COLLINS GRAHAM STANLEY H. KING FRANK W. HUMPHREY

MYRON E. WATSON ROBERT W. HARDING

BDC 1865 · BDC 1865 · BDC 1865 · BDC 1865 · BDC 1865 · BDC 1865 · BDC 1865 · BDC 1865 · BDC 1865 · BDC 1865 · BDC 1865 · BDC 1865

SPECIALISTS in Pre-Fabricating PIPING

STEEL PIPE: Wrought Iron • Steel • Structural • Cast Iron • Copper-Steel • Electric Weld • Seamless • Spiral, Lap & Butt Weld • Shore-Dredge • Speed-Lay

CEMENT-ASBESTOS PIPE: For sewerage and water mains where corrosion is a problem.

ALUMINUM PIPE: In standard and light walls. All accessories stocked.

PLASTIC (PVC) PIPE

SPEED-LAY: Complete packaged PIPE SYSTEM for fast-laying, temporary and semi-permanent lines for water, compressed air and other services. Write for catalog.

VALVES, FITTINGS & FLANGES: Tube Turns • Dresser • Victaulic • Cast Iron or Steel • Forged Steel • Special Alloys • Water Main

PILING PIPE: Cast Steel and Iron Points • Plates and Shoes • Cast Steel • Malleable Iron Sleeves

COMPLETE FACILITIES for Bending, Coiling, Beveling, Swedging, Flanging, Grooving, Welding, Cutting to Sketch, and Threading to most rigid requirements. Bitumastic or Cement lining — Testing — all to Standard specifications.

ALBERT
PIPE SUPPLY COMPANY, INC.

S.G. ALBERT '29 • A.E. ALBERT '56

103-1 VARICK AVE., BROOKLYN 37, N. Y.

Tel.: HYacinth 7-4900

AT YOUR SERVICE

*

SPECIALIZED ENGINEERING
SPECIALIZED EXPERIENCE
SPECIALIZED MACHINERY
FOR
TWISTING · FORMING
STRANDING · BUNCHING
COTTON · JUTE · MANILA
SISAL · NYLON · DACRON
ORLON · SARAN · PAPER
POLYETHYLENE · GLASS

TEXTILE · WIRE · CORDAGE
and OTHER INDUSTRIES

HASKELL-DAWES
MACHINE CO., INC.
2231 E. Ontario Street
Philadelphia 34, Pa.

The TREDENNICK-BILLINGS CO.

Construction Managers *Building Construction*

K. W. RICHARDS '07 H. D. BILLINGS '10 C. C. JONES '12 F. J. CONTI '34

10 HIGH STREET BOSTON, MASSACHUSETTS

HOLMES & NARVER, INC.

ENGINEERS • CONSTRUCTORS

JAMES T. HOLMES M.I.T. '14
D. LEE NARVER STANFORD '14

828 S. Figueroa St., Los Angeles 17, California
Telephone TRinity 8201

SYSKA & HENNESSY, INC.

Engineers

John F. Hennessy '24 — John F. Hennessy, Jr. '51

DESIGN • CONSULTATION • REPORTS
POWER PLANT • WASTE DISPOSAL • WATER SYSTEMS
New York City

CHAUNCY HALL SCHOOL

Founded 1828. The School that specializes in the preparation of students for the Massachusetts Institute of Technology.

Ray D. Farnsworth, *Principal* 533 Boylston Street, *Boston, Mass.*

ALEXANDER KUSKO, INC.

Consulting Engineers

141 Main Street — Cambridge 42, Mass.
ELiot 4-4015

Research and Development in

Magnetics
Electric Machinery
Transistor Circuits
Control Systems

A. Kusko '44
P. N. Heller '51
J. P. Blake, Jr. '54
J. A. Gaudet '56

ROTH LABORATORY FOR PHYSICAL RESEARCH

Serving Industry in these fields —

ELECTRONICS — MATHEMATICAL ANALYSIS
AUTOMATION — RESEARCH MANAGEMENT
MEDICAL PHYSICS — ANALOG COMPUTERS
ULTRASONICS — INSTRUMENTATION

Wilfred Roth M.I.T. '48 Columbia '43

1240 MAIN STREET • JAckson 7-8474
HARTFORD 3, CONNECTICUT

OUR ATOMIC POLICY

(*Concluded from page 428*)

within the three nations – three nations which responsibly know that certain retaliation would be forthcoming if their bombs were used.

Do we try as hard as we should – dispassionately – to understand the Russians? Or do our fears instinctively lead us to firm, but distorted, conclusions? This is a challenge to every thinking citizen.

Many of you have experienced the thrills of participating in a team effort, and of working toward a goal everyone feels is highly important. Once I thought that this was uniquely an American characteristic. My eyes were opened when 20 scientific secretaries came to the United Nations Building to work with me to prepare for and to operate the conference that was to be held a few months later in Geneva. Within 10 days those men, coming from 14 different nations, had become a team with an *esprit de corps* that made them feel they could tackle and lick any problem that might arise. I can personally testify that Russians, Argentineans, Pakistanis, Yugoslavs, and French can respond in a loyal team to the challenge of a great task in the same way that Americans, British, and Canadians can.

It may seem too visionary to believe that man can rise above his historic nationalism to assure a good life for his grandchildren. But the Proverbs tell us: "where there is no vision, the people perish." These words are poignantly apt today. I have faith that the resources of imagination, of intelligence, and of courage in able men everywhere can and will be enlisted to make the vision a reality.

meissner Engineers

consultants • engineers • constructors

Processing plants. Bulk materials handling and storage. Conveying systems. Ore and minerals processing. Bridge, expressway and interchange design.

JOHN F. MEISSNER ENGINEERS, INC.
300 West Washington Street
Chicago 6, Illinois
ANdover 3-1944

R. C. MEISSNER '43

LOCKWOOD GREENE

ENGINEERS—ARCHITECTS

Professional Service from Site Selection to Plant Completion

Plant Location Studies
Site Investigations
Complete Design
Supervision of Construction

REPORTS — APPRAISALS

New York — BOSTON, MASS. 316 STUART ST — Spartanburg, S. C.

PROFESSIONAL CARDS

JACKSON & MORELAND, INC.

Engineers and Consultants

DESIGN AND SUPERVISION OF CONSTRUCTION

REPORTS—EXAMINATIONS—APPRAISALS

MACHINE DESIGN—TECHNICAL PUBLICATIONS

BOSTON NEW YORK

GANNETT FLEMING CORDDRY AND CARPENTER, INC.

Engineers

HARRISBURG, PA.

Branch Offices:

Pittsburgh, Pa. Daytona Beach, Fla. Philadelphia, Pa.

Expressways, Toll Roads, Bridges and Airports. Traffic & Parking. Dams, Water Works, Sewage, Industrial Wastes and Garbage Disposal. Appraisals, Investigations and Reports.

EADIE, FREUND & CAMPBELL

CONSULTING ENGINEERS

500 FIFTH AVENUE NEW YORK 36, N. Y.

Mechanical — Electrical — Sanitary

Air Conditioning — Power — Process Layouts

James K. Campbell '11

METCALF & EDDY

Engineers

Water, Sewage, Drainage, Refuse and Industrial Wastes Problems

Airports, Laboratory, Valuations

Statler Building, Boston 16, Mass.

THE KULJIAN CORPORATION

Consultants • Engineers • Constructors

UTILITY • INDUSTRIAL • CHEMICAL

Power Plants (Steam, Hydro, Diesel), Textile Plants, Water & Sewage Works, Oil Refineries, Pipe Lines, Army & Navy Installations, Air Fields, Hangars

H. A. Kuljian '19 A. H. Kuljian '48

1200 NO. BROAD ST., PHILADELPHIA 21, PA.

FABRIC RESEARCH LABORATORIES, INC.

Research, Development, and Consultation

In the Fields of Fibrous, Organic, and Related Materials

1000 Providence Highway Dedham, Mass.

(At Route 128 and U.S. 1 Interchange)

W. J. HAMBURGER, '21 K. R. FOX, '40 E. R. KASWELL, '39

GILBERT ASSOCIATES, INC.

ENGINEERS AND CONSULTANTS

Malcolm G. Davis '25, *Vice President*

Allen W. Reid '12 E. C. Edgar '35

Steam, Hydro, Diesel Power Plants; Industrial Structures; Plant Safety, Utility Rates, Valuations, Reports; Large Scale Purchasing; Chemical Laboratory

New York • READING, PA. • Washington

FAY, SPOFFORD & THORNDIKE, INC.

Engineers

Airports, Bridges, Turnpikes

Water Supply, Sewage and Drainage

Port and Terminal Works, Industrial Buildings

Designs Investigations

Supervision of Construction

Boston, Massachusetts

CLEVERDON, VARNEY & PIKE

Consulting Engineers

HERBERT S. CLEVERDON '10 WALDO F. PIKE '15

JOHN A. DOW '23 HAROLD E. PROCTOR '17

Structural Designs Foundations

Heating, Ventilating, Electric and Plumbing Designs, Industrial Buildings, Reports, Investigations

120 TREMONT STREET BOSTON 8, MASS.

MAURICE A. REIDY

Consulting Engineer

BRIDGES BUILDINGS

STRUCTURAL DESIGNS FOUNDATIONS

CONSTRUCTION CONSULTANT AND ARCHITECTURAL ENGINEER

Estimates and Appraisals

101 TREMONT STREET BOSTON, MASS.

CHARLES NELSON DEBES AND ASSOCIATES

ENGINEERS AND CONSULTANTS

Architectural — Mechanical — Electrical — Structural — Sanitary

Industrial, Commercial and Municipal Projects

915 EAST STATE ST. ROCKFORD, ILL.

C. N. DEBES '35

MORAN, PROCTOR, MUESER & RUTLEDGE

CONSULTING ENGINEERS

Foundations for Buildings, Bridges and Dams; Tunnels, Bulkheads, Marine Structures, Soil Studies and Tests; Reports, Design and Supervision

WILLIAM H. MUESER '22 PHILIP C. RUTLEDGE '33

415 Madison Ave., New York 17, N. Y.

BREWER ENGINEERING LABORATORIES

Consulting Engineers

Electric Strain Gage Testing • Stress Analysis

Strain Gage Amplifiers • Strain Gage Switches

High Temperature Strain Gages

MARION, MASS. TEL. 103

C. A. Brewer '38 S. P. Cammack '57

CAPITOL ENGINEERING CORPORATION

CONSULTING ENGINEERS

Design and Surveys

Roads and Streets

Sewer Systems Water Works

Planning Airports

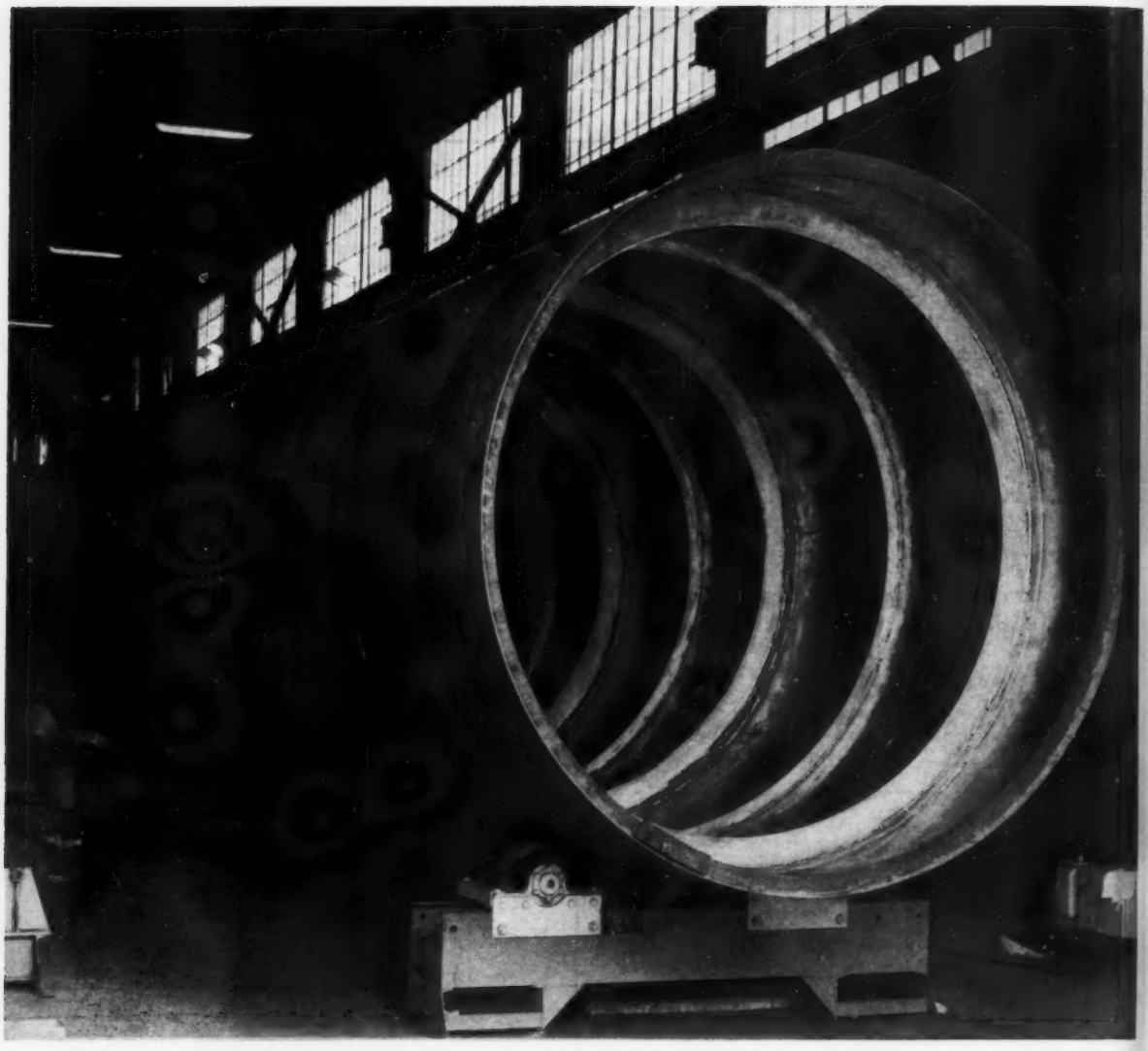
Bridges • Turnpikes • Dams

Executive Offices

DILLSBURG, PENNSYLVANIA

Washington, D. C. Saigon, Vietnam Rochester, N. Y.

Robert E. Smith '41, Vice President



For Storage at 297° Below... Under Vacuum

Liquid oxygen is cold stuff. Boiling at 297° below zero, it must be contained in a thoroughly insulated vessel to prevent intolerable evaporation losses. This 9′ x 40′3″ section, of Type 304 stainless, is the inner compartment of a giant vacuum bottle for liquid oxygen storage. To assure a perfect vacuum, the welds must remain tight over a wide range of temperatures, requiring extreme care in selection of materials and laying in of welds. Applying experienced craftsmanship to such fabrication problems as this is nothing new at Graver. Many years of cryogenic research assures a safe, trouble-free, low-temperature vessel that will give long service. At whatever temperature your product must be stored or processed, you will find the type of custom fabrication you require at Graver.

GRAVER
ALLOY DIVISION

Building for the Future on a Century of Craftsmanship in Steels and Alloys

GRAVER TANK & MFG. CO., INC.
EAST CHICAGO, INDIANA
New York • Philadelphia • Edge Moor, Delaware • Pittsburgh
Detroit • Chicago • Tulsa • Sand Springs, Oklahoma • Houston
New Orleans • Los Angeles • Fontana, California • San Francisco

Excess HCl?

Limited Sales?

Disposal Expensive?

UHDE

$2HCl \rightarrow H_2 + Cl_2$

Recover Chlorine.

UHDE CELLS FOR HCl ELECTROLYSIS

CHEMICAL PROCESS DESIGN

THE UHDE CORPORATION

350 FIFTH AVENUE, NEW YORK 1

The GR® Type 1530-A Microflash provides a "blinding" white light of short duration for single-flash photography of very rapidly moving objects. Flash intensity is *50 million* candle power — duration is only *2 millionths* of a second. During this short flash duration, an object moving at 1000 feet per second is displaced only two hundredths of an inch. Consequently, sharp photographs are readily obtained without blurring.

This instrument has been successfully applied to the study of many phenomena in pure and applied science, including investigations of the effects of abrasion, turbulence in liquids, and mechanical distortion at high rotational speeds. Other applications have included study of the disintegration of high-speed rotors, investigation of projectile flight and impact, and experimentation dealing with the propagation of fractures in various materials. In mechanical design, the Microflash has proved an indispensable tool for studying the action of springs, valves, cams, cranks, bearings and other parts moving at high speeds.

- ✔Power supply and trigger circuits are assembled in one metal case, lamp is in another. Two sections lock together for complete protection of all controls and ease in transportation.
- ✔Panel pushbutton initiates flash. Flash can also be tripped by noise or pressure wave associated with the action to be photographed; microphone and built-in amplifier are provided for such use.
- ✔Additional jack is available for flashing from any simple external contactor . . . from photoelectric cell, wire breaking under tension or impact, and other easily-built devices to suit the application.
- ✔Conventional camera equipment is used.
- ✔Accessories supplied include microphone with cable, tripod, spare pilot lamps and fuses, 2 spare flash lamps, and plug for connection to external-contactor trip jack.
- ✔Dimensions are 24⅛ x 13¼ x 11¾ inches, overall.
- ✔Net Weight is 72 pounds.
- ✔Price — $695.

Above: First photograph shows 20mm bullet just reaching scatter-proof glass. Focal point of concussion is readily seen along with maximum radius of fracture.

ULTRA-HIGH-SPEED PHOTOGRAPHY with G-R TYPE 1530-A MICROFLASH

Below: As bullet passes through, second photo indicates progressive shattering which is fairly well confined to point of contact.

GENERAL RADIO Company

275 Massachusetts Avenue, Cambridge 39, Mass., U. S. A.

NEW YORK AREA: Tel. N. Y. WOrth 4-2722, N. J. WHitney 3-3140 **CHICAGO:** Tel. Village 8-9400
PHILADELPHIA: Tel. HAncock 4-7419 **WASHINGTON, D. C.:** Tel. JUniper 5-1088
SAN FRANCISCO: Tel. Whitecliff 8-8233 **LOS ANGELES 38:** Tel. HOllywood 9-6201
In **CANADA, TORONTO:** Tel. CHerry 6-2171

WE SELL DIRECT. Our District Sales Offices are staffed by engineers especially trained to help you in the selection of instruments and measuring systems best suited to your needs. We welcome your inquiries — will help solve your problems.